昭和56年度

スワジランド北国石炭開発計画調査

中間報告書

昭和57年3月

国際協力事業団

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添付資料

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ま え が き

スワジランド王国政府の要請により同国炭田のルブク（Lubhuku）地域の石炭開発計画を目的として、昭和５５年３月２５日に同国政府との間で「Scope of Work」が締結され、これに基づいて昭和５５年度の試錐工事が同年１２月から昭和５６年３月にかけて実施された。（試錐本数９孔、総掘削長2,825.62ｍ）

昭和５６年度の調査はこれに引続き、昭和５６年４月２７日に試錐下請業者選定の為、スワジランド政府による公開入札公告が行なわれ、６月に業者（南アフリカ共和国のInterdrills (Pty) Limited)が決定した。同年７月１８日にルブク調査団協議班がスワジランド王国に派遣され、昭和５６年度の試錐工事実施に関して同国政府と協議を重ねた結果、７月２８日付で試錐工事実施に係る「Agreement」を締結した。一方、スワジランド政府と試錐下請業者との間で試錐工事実施に関する「Subcontract」が７月３０日に締結された。ルブク調査団試錐班が８月１日に同国に派遣され、作業準備を引継ぐと共に爾後の調査作業の指導、監督を行った。

試錐実施に先立ち、炭座、炭質等に影響を与えているドレライトの掘削を避ける為に、試錐予定位置周辺で磁気探査（測線伐開を含む）を行った。

試錐作業は昨年度断層帯及び破砕・粉化ドレライトに遭遇し、孔内崩壊、ジャミング激しく、３孔（ＤＤ８、ＤＤ１０、ＤＤ４８）が掘削中断となった苦い経験に鑑み、本年度は全試錐機ともワイヤライン工法とした。本年度は昨年度の如く集中豪雨に見舞れる事もなく、常時２方操業を行うと共に雨季の対策も充分に講じたので、関係者一同の努力と相まって予定どおり工事を完了する事が出来た。

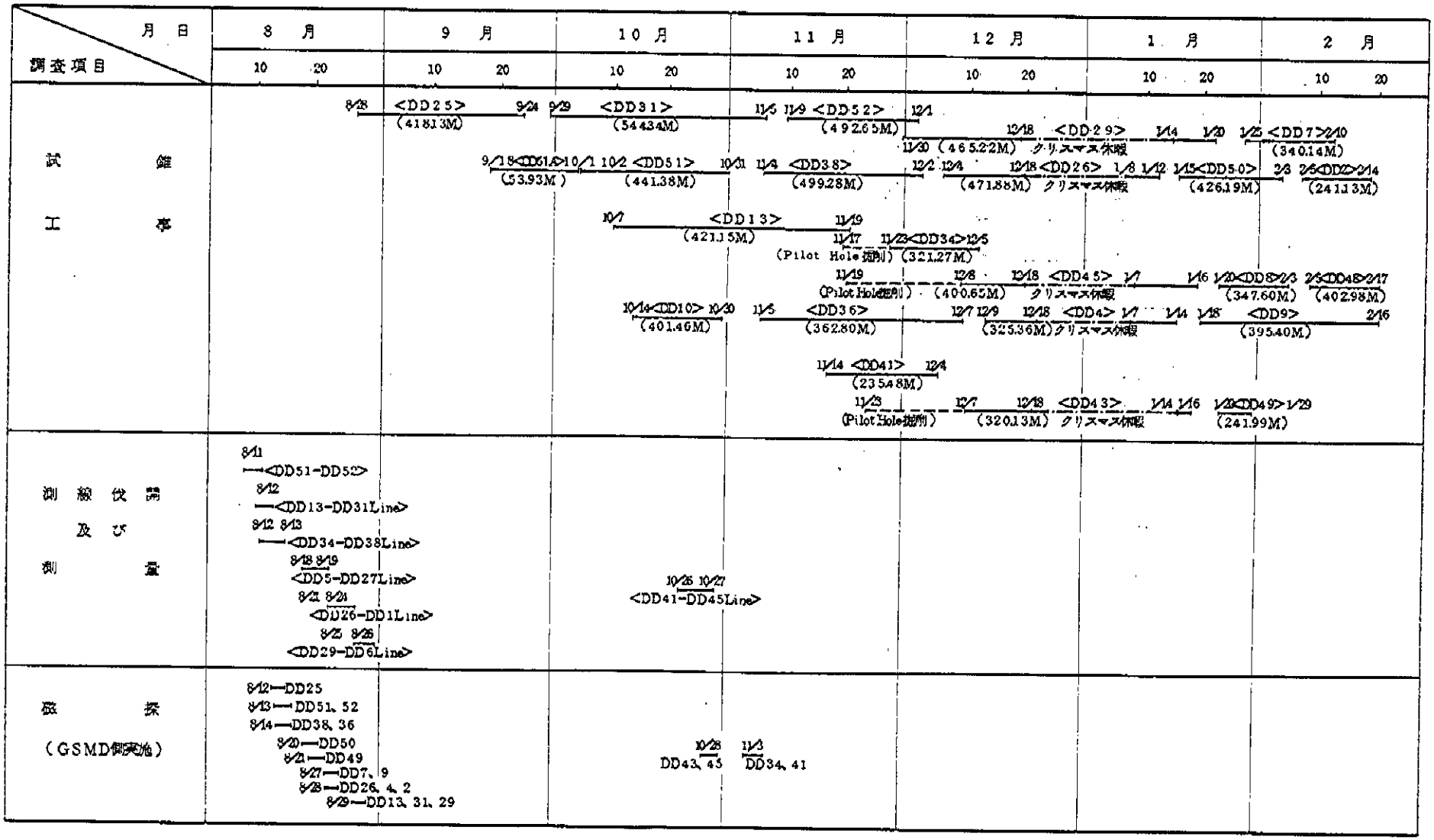
試錐は調査対象地域内で原則として２㎞間隔とし、調査の成果を有意義なものにすべく、ドレライトの貫入が特に著るしいと予想される東南部及び西南部は避け、炭層が安定して発達するとみられる中部及び北部の東西方向２測線で１㎞間隔の試錐を実施した。

当初は２２孔（昨年度中断した３孔の継続を含む）、総掘削長7,160ｍを予定していたが、特に南部で予想以上にドレライトの貫入が多く目的とする炭層までの掘削長が計画を越えたこと、及び昨年度の継続２孔がロッド切断の為に孔曲げ掘削せざるを得なかったことで、約675ｍの増尺となり、試錐工事は２２孔、総掘削長7,835.22ｍで昭和５７年２月１７日に無事完了した。本年度はさしたるトラブルもなく、昨年度中断した３孔も当初計画した深度までの

掘削に成功し、調査団は予定どおり3月3日（団員）及び3月4日（団長）に各々帰国した。

本年度実施した試錐では15孔でMain Seamを捕捉しており、浅部試錐によって確認されている主要炭層が地表下400～450m以深へ連続していることは明らかである。しかしながら、深部における炭層の賦存状況は部分的にドレライトの貫入及び断層の影響を相当に受けており、今後の解析及び調査により逐次解明されるものと期待される。

調　査　工　程　表


月日
調査項目
8月
9月
10月
11月
12月
1月
2月
10
20
試錐工事
<DD25> (418.13M)
<DD31> (544.34M)
<DD52> (492.65M)
<DD29> (465.22M) クリスマス休暇
<DD7> (340.14M)
<DD61> (53.93M)
<DD51> (441.38M)
<DD38> (499.28M)
<DD26> (471.88M) クリスマス休暇
<DD50> (426.19M)
<DD2> (241.13M)
<DD13> (421.15M)
(Pilot Hole掘削) (321.27M)
(Pilot Hole掘削) (400.65M) クリスマス休暇
<DD8> (347.60M)
<DD48> (402.98M)
<DD10> (401.46M)
<DD36> (362.80M)
(325.36M) クリスマス休暇
<DD4> <DD9> (395.40M)
<DD41> (235.48M)
(Pilot Hole掘削)
(320.13M) クリスマス休暇
<DD43> <DD49> (241.99M)
測線位置及び測量
8/11 <DD51-DD52>
8/12 <DD13-DD31Line>
8/12 8/13 <DD34-DD38Line>
8/18 8/19 <DD5-DD27Line>
8/21 8/24 <DD26-DD1Line>
8/25 8/26 <DD29-DD6Line>
10/26 10/27 <DD41-DD45Line>
磁探（GSMD側実施）
8/12—DD25
8/13—DD51、52
8/14—DD38、36
8/20—DD50
8/21—DD49
8/27—DD7、9
8/28—DD26、4、2
8/29—DD13、31、29
10/26 DD43、45
11/3 DD34、41

派　遣　技　術　者

氏　　名	担　当	所　　属	派　遣　期　間
野　崎　　元	総括・地質	住友石炭鉱業㈱ 海外石炭開発部	昭和56年7月18日～8月1日 昭和57年2月12日～3月4日
菅　原　通　敬	地　　質	同　　上	昭和56年7月18日～8月16日
畠　山　広　一	試錐・測量	同　　上	昭和56年8月1日～ 昭和57年3月3日
石　原　紀　夫	地質・試錐	同　　上	昭和56年8月1日～ 昭和57年3月3日

1　調査の目的と内容

1.1　調査の目的

スワジランド王国政府より要請のあった同国北部炭田のうち、最も炭層条件が良いと予測されるルブク地域（第１図）の炭層賦存状況を調査し、将来の炭鉱開発の可能性を検討する際の基本的資料（炭層賦存深度、炭層厚、埋蔵炭量等）の作成を調査の目的とする。

調査の対象はカルー（Karroo）系の中部エッカ（Ecca）統中の下部夾炭層（Lower Coal Zone）の炭層群（第２図）のうち、主として地表から２００ｍ以深の深部に賦存する炭層である。

昭和５５年度の第一段階調査（調査範囲は地域北部に限定）に引続き、昭和５６年度は第二段階として調査対象全地域において試錐を主とする探鉱を実施した。本年度実施した試錐位置を第３図に示す。

1.2　測　　量

当初計画した試錐位置の測量についてはスワジランド側で実施し、磁気探査の結果等により試錐位置を変更した場合はそれらの基点にもとづき、変更後の試錐地点の測量を本調査団が行った。実際に行なわれた試錐位置の座標及び標高を第１表に示す。

1.3　磁気探査

試錐予定位置を中心にして、東西・南北各々２００ｍの測線上でそれぞれ５ｍ乃至１０ｍ毎に磁気測定を行い、ドレライトの貫入状況を解析した。試錐予定位置にドレライトの貫入が予想される場合は５０ｍ間隔で測線をずらし、同様の方法で磁気測定を行った。このデータに基づいて、ドレライトの掘削を最少に留めるよう実際の試錐地点を決定した。

磁気探査の結果では地表近くにみられるドレライトの岩脈についてはその分布位置をほぼ予測できるが、ドレライトのシル及び深部における岩体の予測は殆んど不可能である。磁気探査結果の代表的な例を第４、５図に示す。

1.4　試　　錐

本年度の試錐は昨年度実施した９本も含め調査対象地域内で原則として２㎞間隔となる

FIGURE 1.

EXISTING AND POTENTIAL COAL MINES – OCTOBER 1978

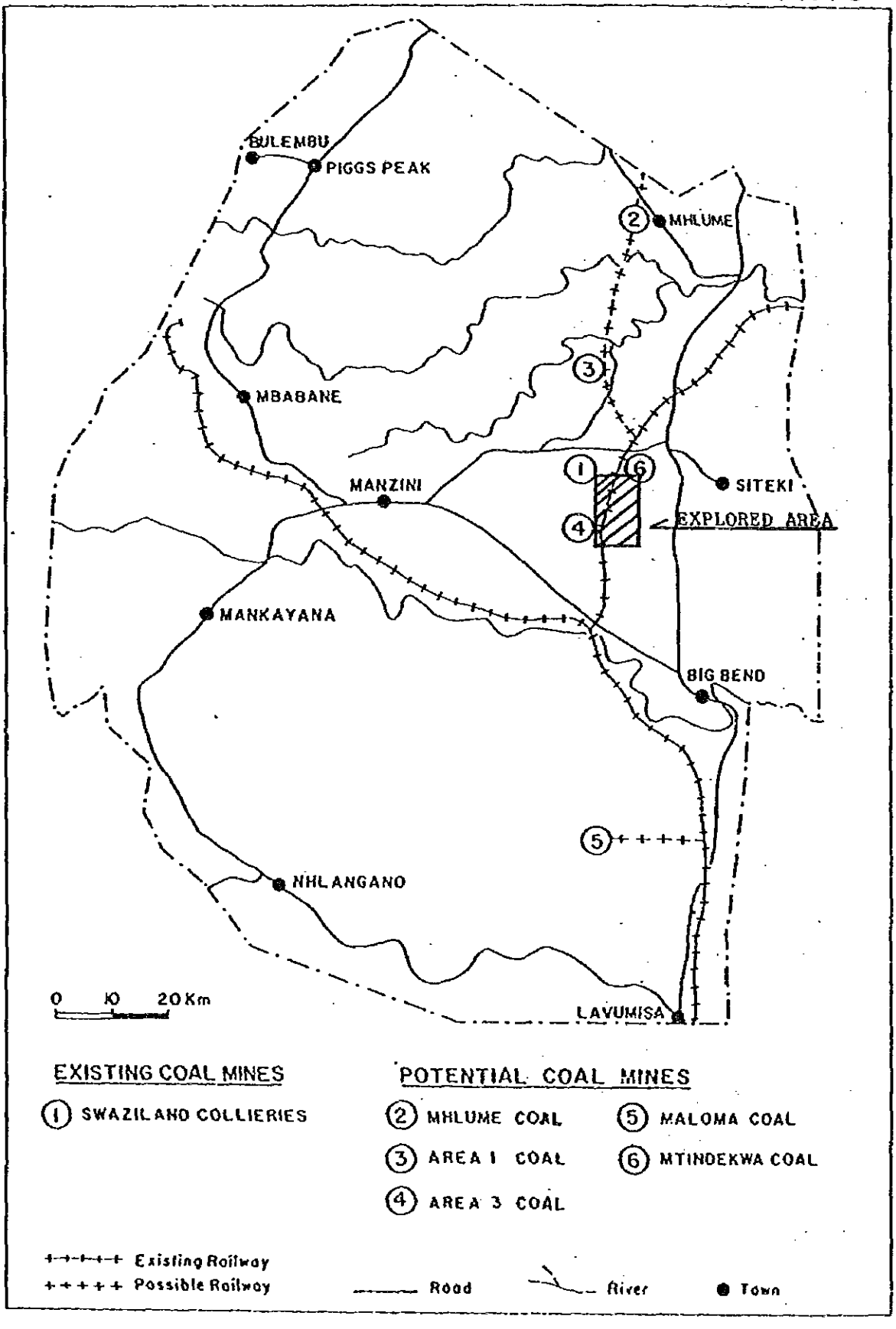
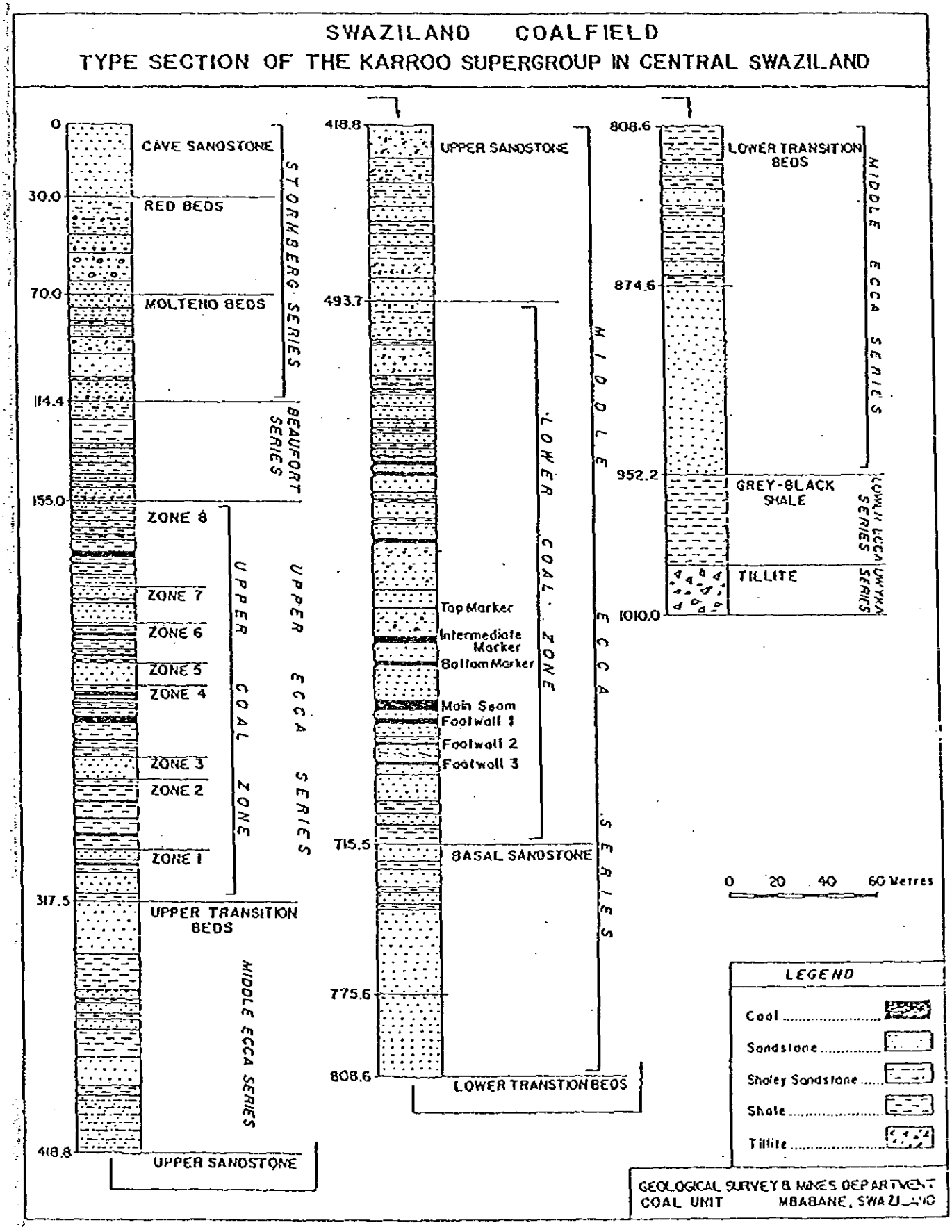


FIGURE 2.


SWAZILAND COALFIELD
TYPE SECTION OF THE KARROO SUPERGROUP IN CENTRAL SWAZILAND
0
CAVE SANDSTONE
30.0
RED BEDS
70.0
MOLTENO BEDS
STORMBERG SERIES
114.4
BEAUFORT SERIES
155.0
ZONE 8
ZONE 7
ZONE 6
ZONE 5
ZONE 4
ZONE 3
ZONE 2
ZONE 1
UPPER COAL ZONE
UPPER ECCA SERIES
317.5
UPPER TRANSITION BEDS
MIDDLE ECCA SERIES
418.8
UPPER SANDSTONE
418.8
UPPER SANDSTONE
493.7
LOWER COAL ZONE
Top Marker
Intermediate Marker
Bottom Marker
Main Seam
Footwall 1
Footwall 2
Footwall 3
MIDDLE ECCA SERIES
715.5
BASAL SANDSTONE
775.6
808.6
LOWER TRANSTION BEDS
808.6
LOWER TRANSITION BEDS
MIDDLE ECCA SERIES
874.6
952.2
GREY-BLACK SHALE
LOWER ECCA/DWYKA SERIES
TILLITE
1010.0
0 20 40 60 Metres
LEGEND
Coal
Sandstone
Shaley Sandstone
Shale
Tillite
GEOLOGICAL SURVEY & MINES DEPARTMENT
COAL UNIT MBABANE, SWAZILAND

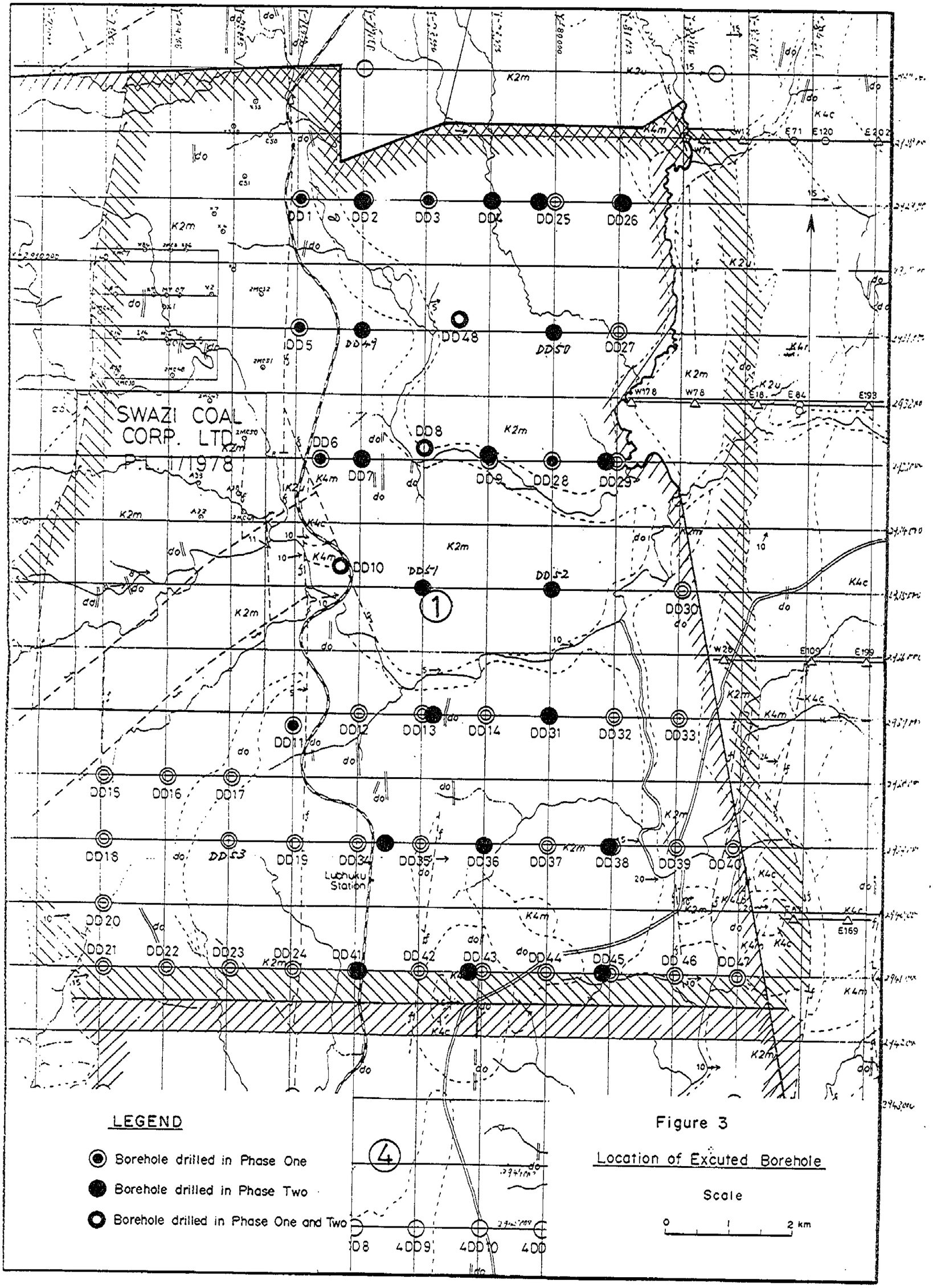
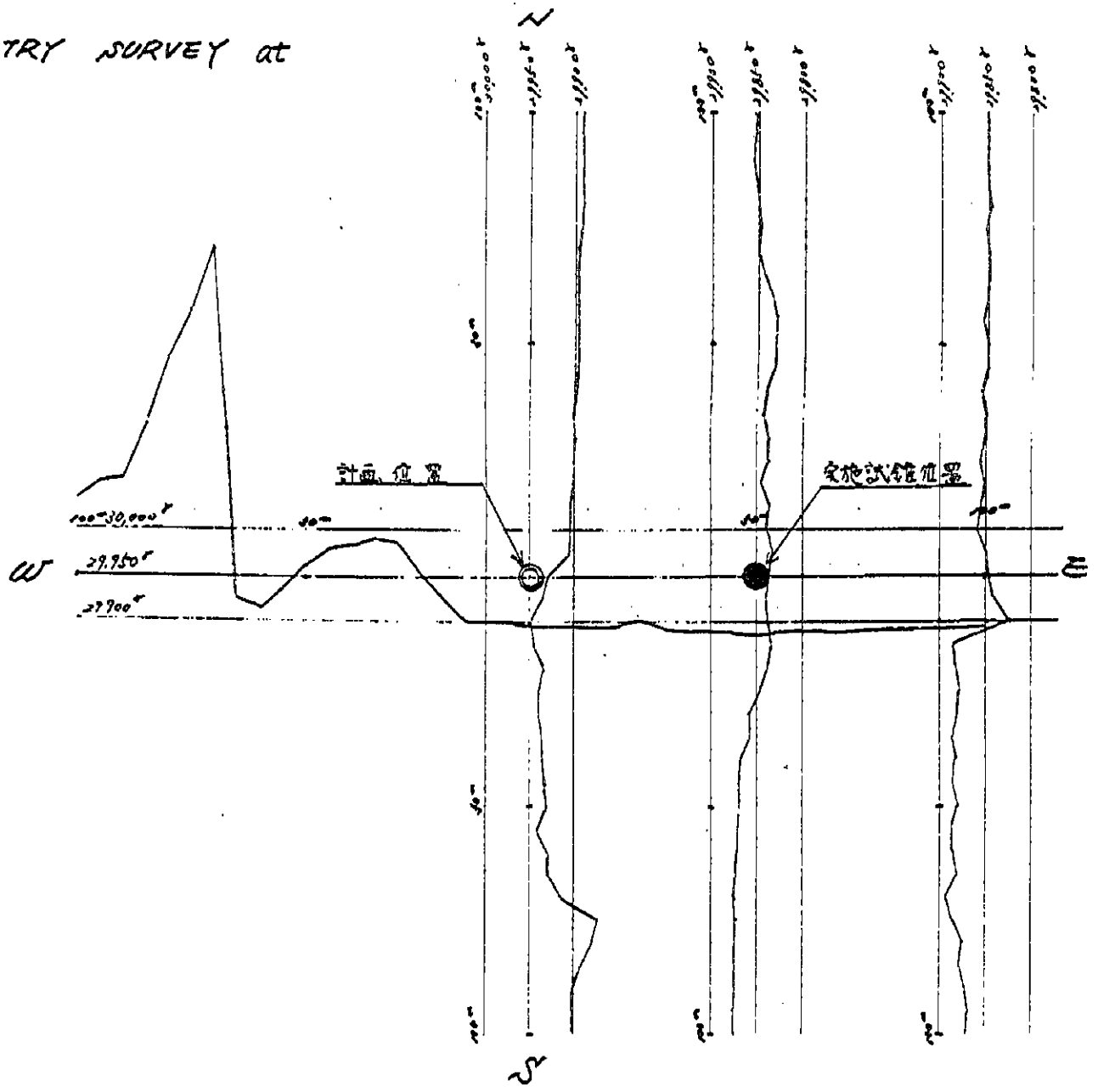


Figure 3

Location of Excuted Borehole

Figure 4
MAGNETOMETRY SURVEY at
DD26



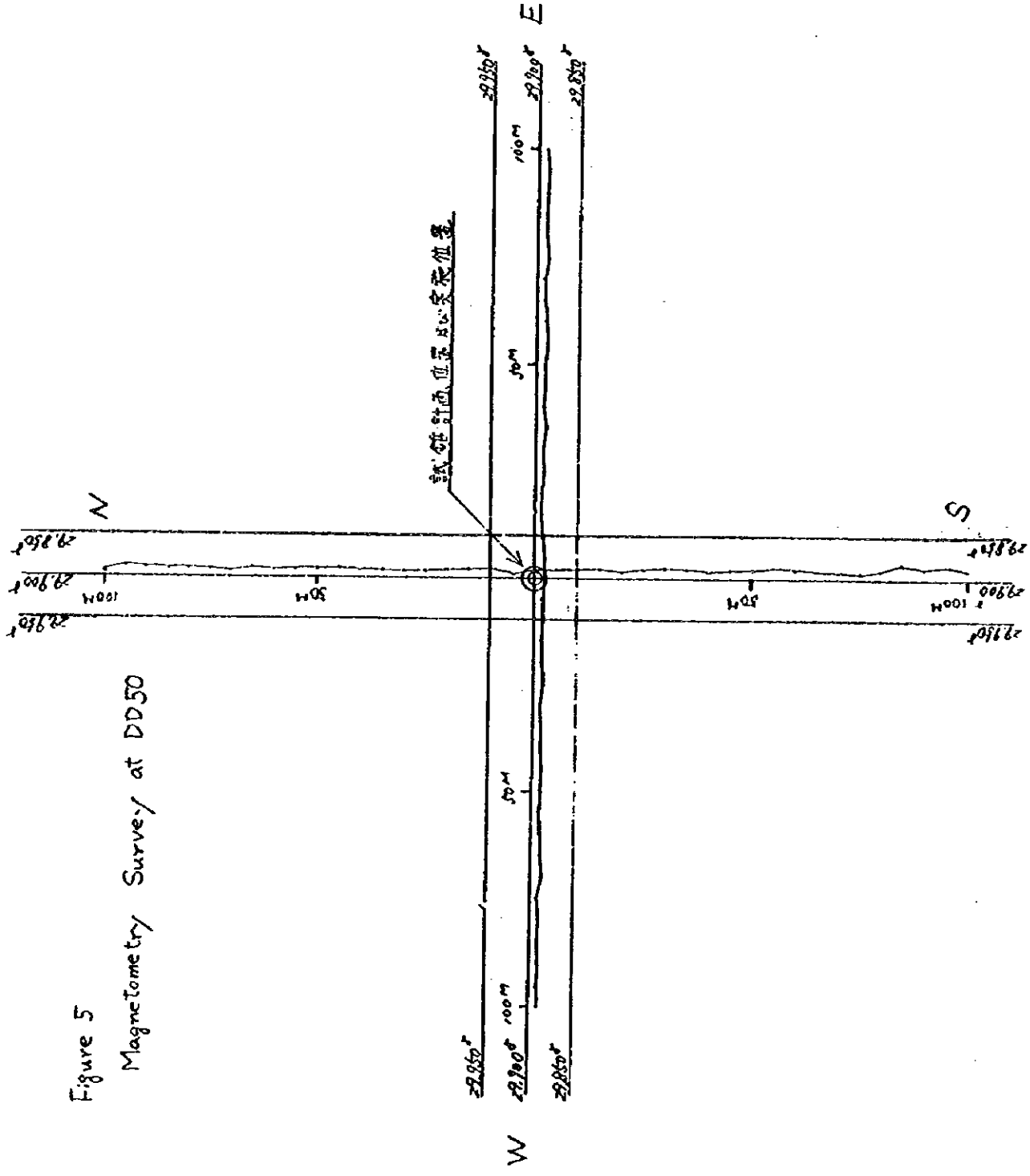


Figure 5
Magnetometry Survey at DD50

ように計画した。地表における地質状況及び南部で実施した試錐結果から判断して、特にドレライトの貫入が著るしいと予想される東南部及び西南部は避けて、既存の地質資料から炭層の賦存状況が最も安定しており、調査の成果が最も大きいとみられる中部及び北部の東西方向２測線では１㎞間隔で試錐を実施した。（第３図）

当初計画では試錐孔２２本（昨年度中断した３孔の継続を含む）、総掘削長7,１６０ｍを予定していたが、下記理由により約６７５ｍの増尺となり総掘削長は7,８３５.２２ｍとなった。

1）特に南部で予想以上にドレライトに逢着し、目的とする層準までの掘削長が計画を越えたこと。

2）昨年度中断した３孔の内、ＤＤ８は孔内崩壊激しく残留ロッドの回収不可能、又、ＤＤ４８は一旦孔底まで達したが、再び崩壊が発生し、ロッドのしめつけを起し、この回復作業中にロッドの切断を生じ、これの回収が不可能の為、いずれも切断ロッドの上から孔曲げ掘削を行ったこと。

1.5　岩石記載とその解析作業

各試錐孔とも風化帯を除いてオール・コアリングであり詳細な岩相調査が可能なので、各孔とも縮尺１：２００の柱状図を作成した。一方、全試錐孔の縮尺１：５００の炭層対比図（第６図）を作成し、掘削中の解析作業の資料とした。また、原則として厚さ１０㎝以上の炭層部分については別に縮尺１：２０の炭柱図を作成した。代表的な炭柱図を第７～１１図に示す。

1.6　物理検層

本年度はスワジランド側の都合で現在までに物理検層の完了したのはＤＤ１０、DD13、ＤＤ２５の３孔であるが、今後検層を継続し昭和５７年５月末までにその結果を日本側に送付する事になっている。（資料２参照）

今回実施した測定種目は昨年度と同じく次の５種類である。

1）Gamma Ray

2）Neutron-Neutron

3）Caliper

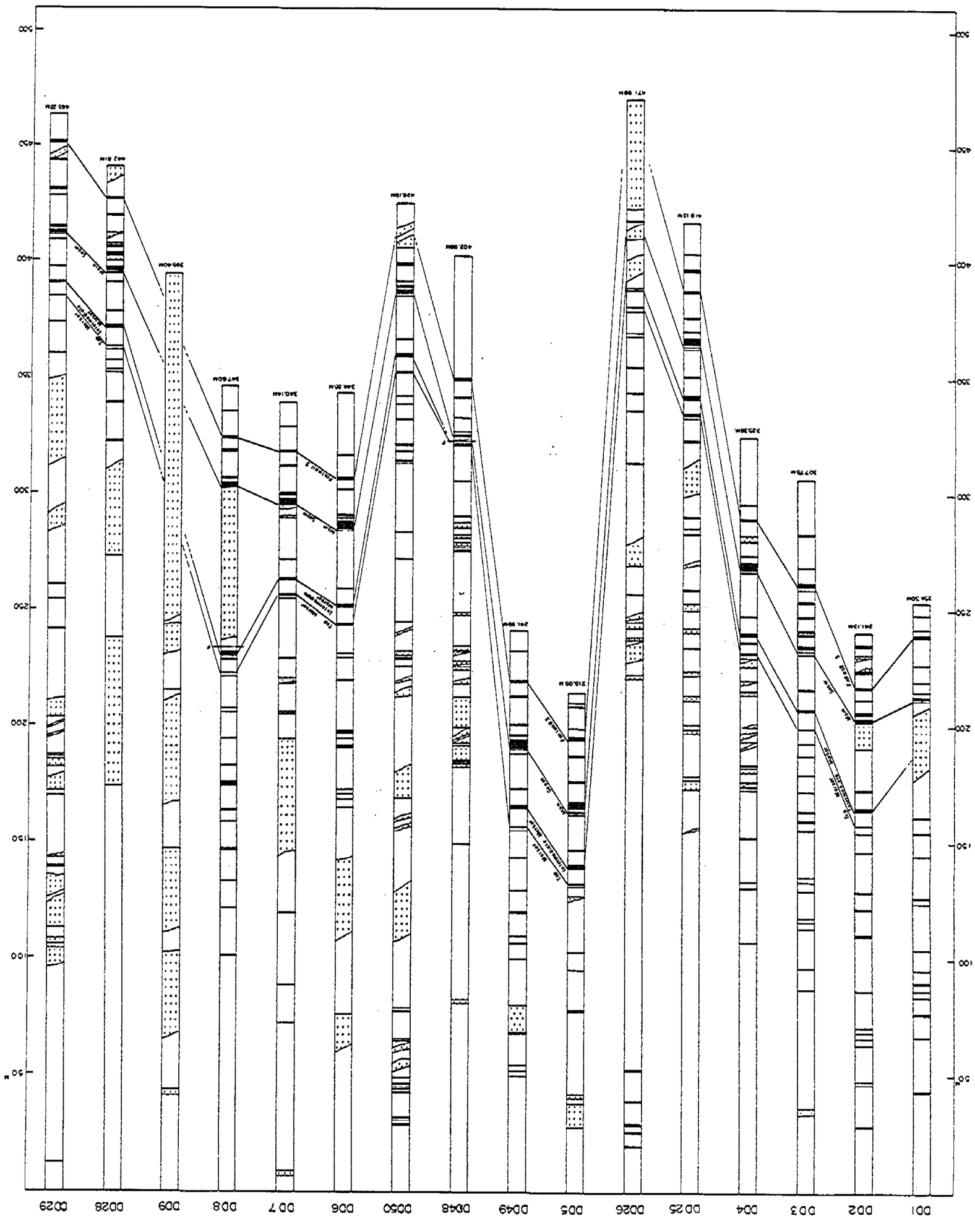
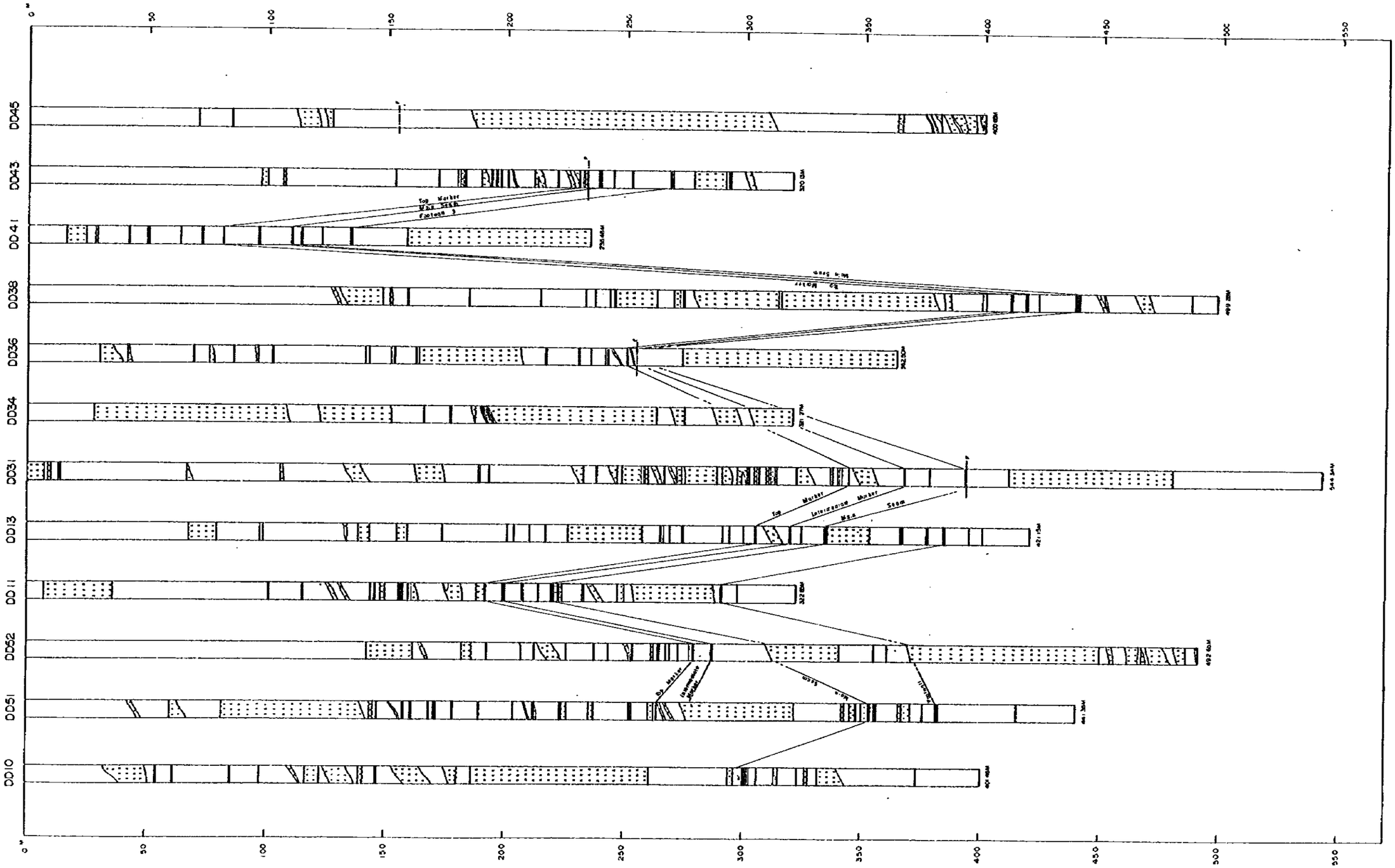


Figure G-1 Correlation of Coal Seams

Figure 6-2 Correlation of Coal Seams



LEGEND

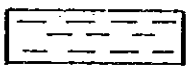
coal, bright

coal, dull

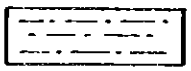
coal, bright, banded dull coal

coal, shaly or shale, coaly

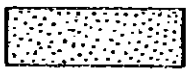
shale, carbonaceous



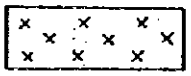
shale



shale, sandy



sandstone

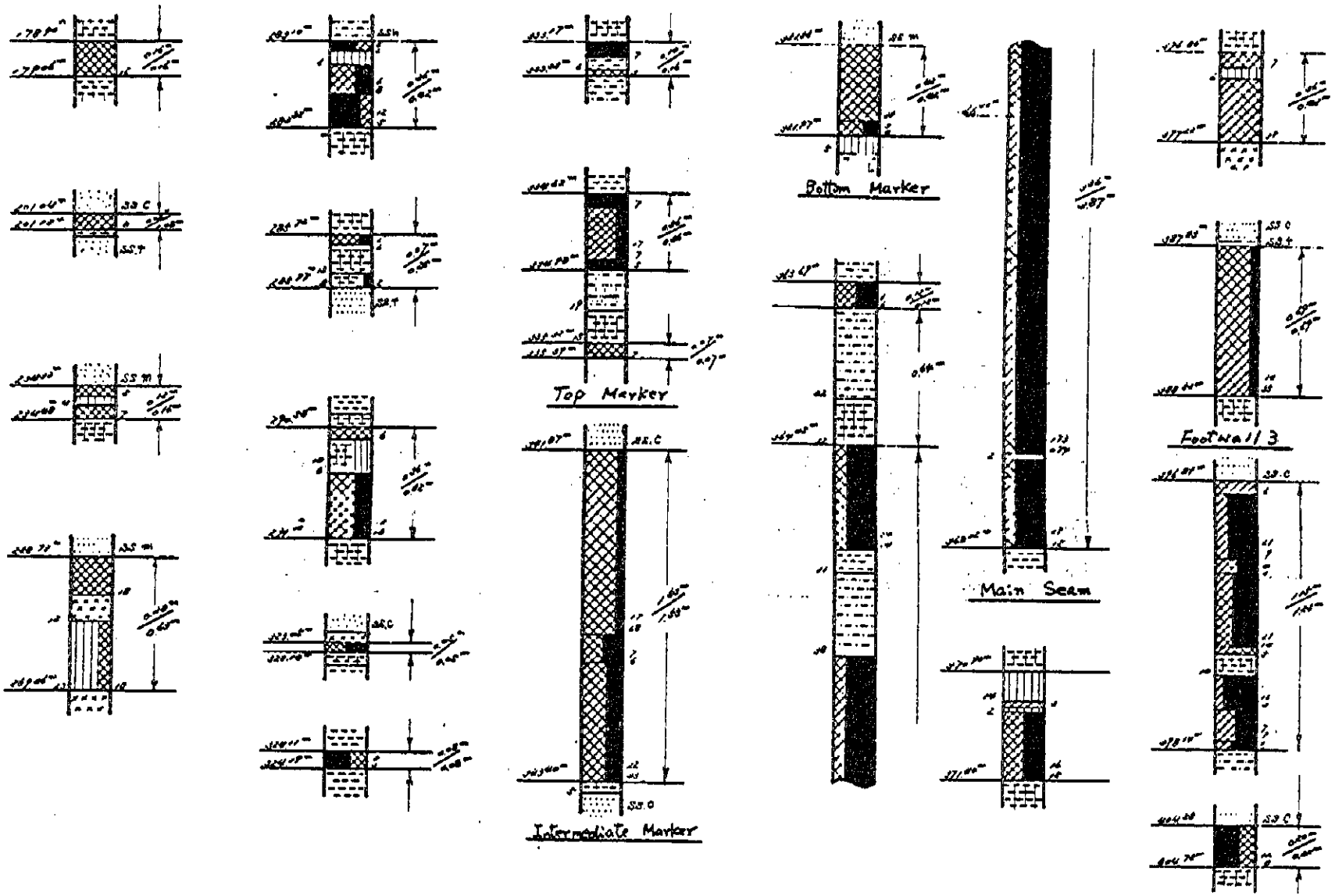


dolerite

DD 25.

S = 1 : 20

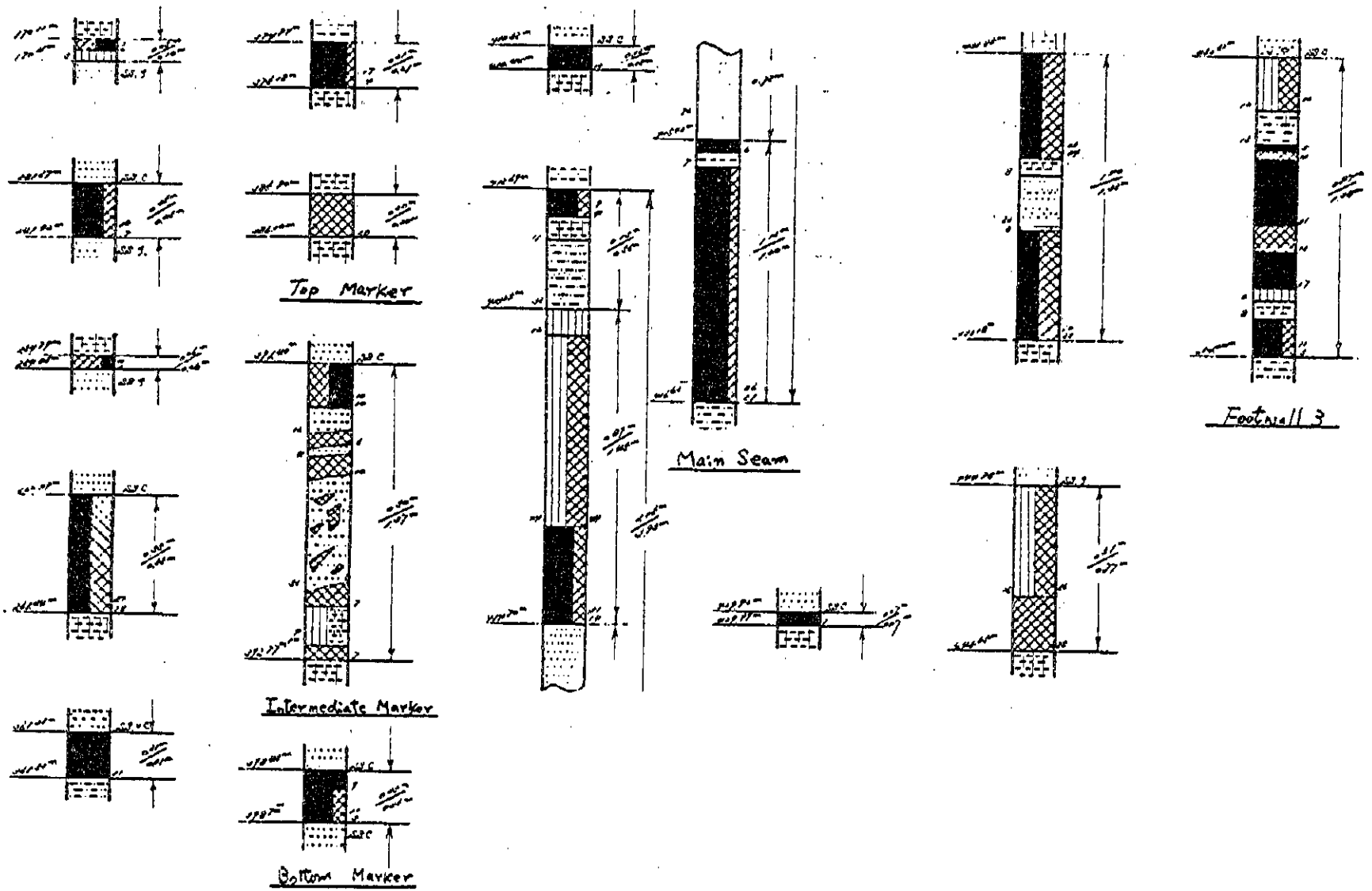
Figure 7 Columnar Coal Section of DD25



DD 29.

S = 1 : 20.

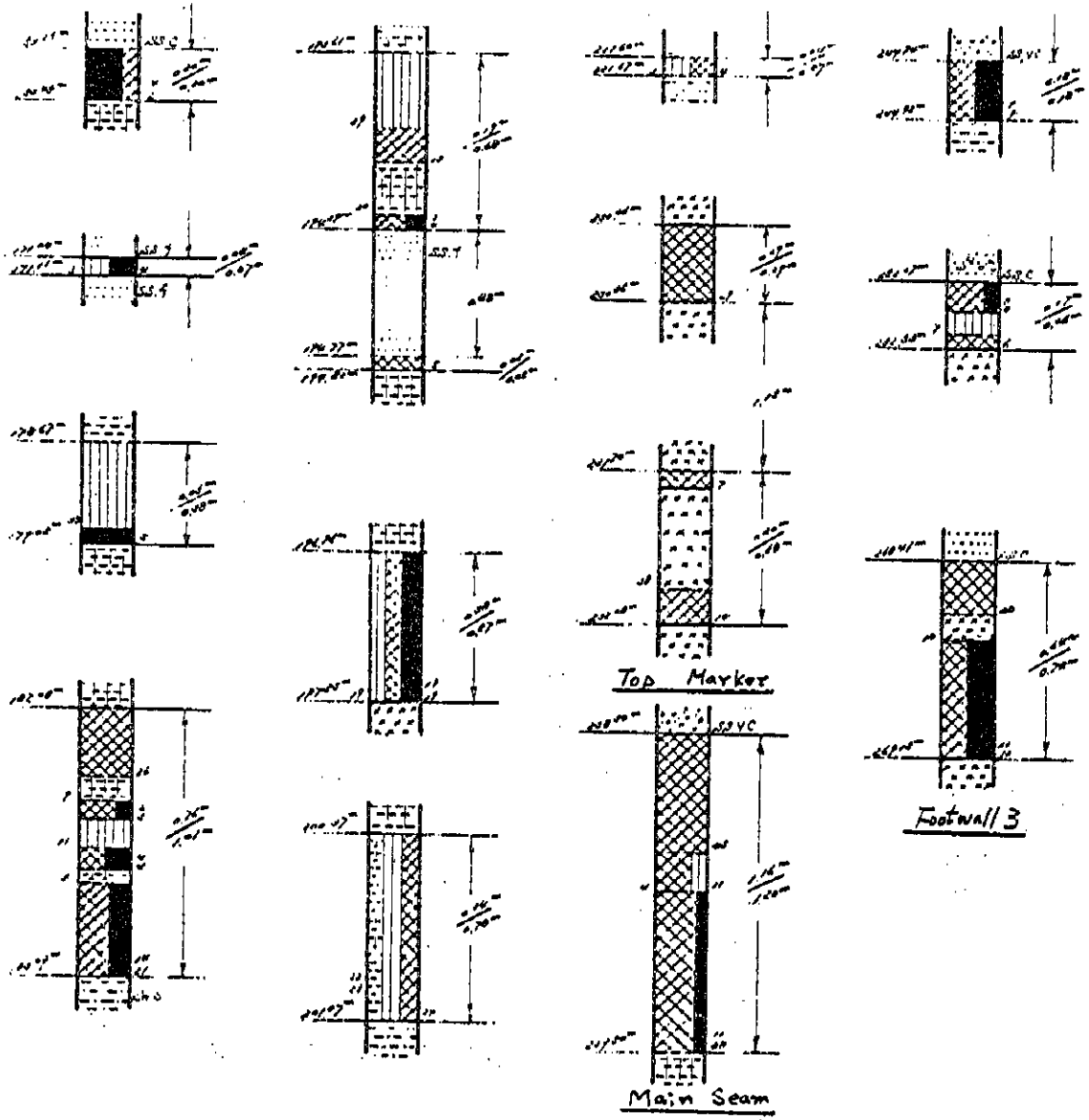
Figure 8 Columnar Coal Section of DD29



DD 43.

S = 1 : 20

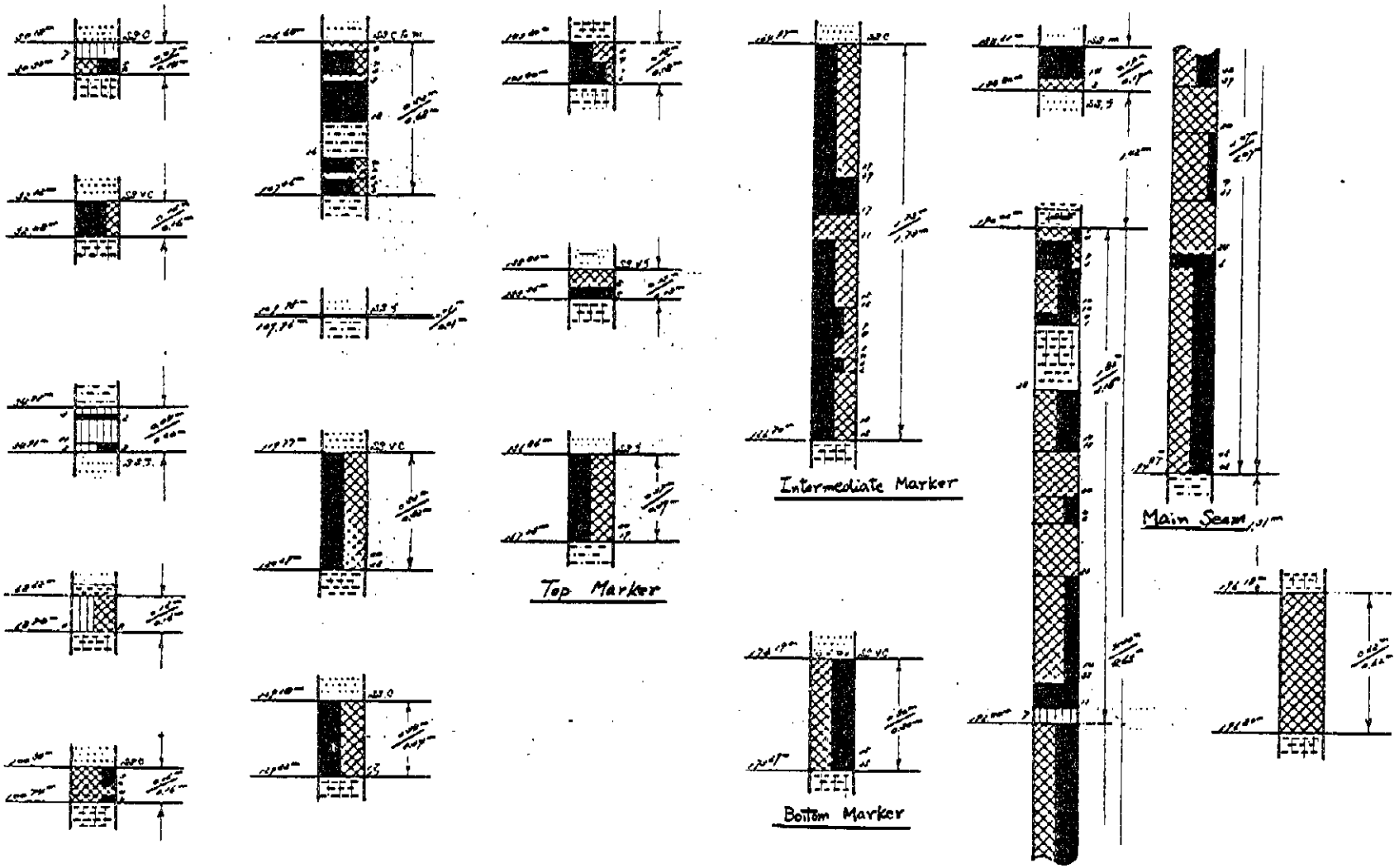
Figure 9 Columnar Coal Section of DD43



DD 49. No 1.

S = 1 : 20

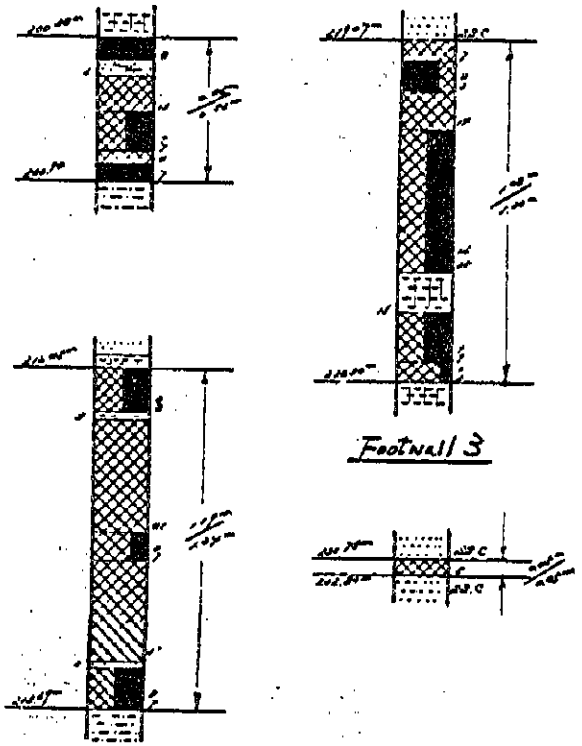
Figure 10-1 Columnar Coal Section of DD49



DD 49. NO2

S = 1 : 20

Figure 10-2 Columnar Coal Section of DD49

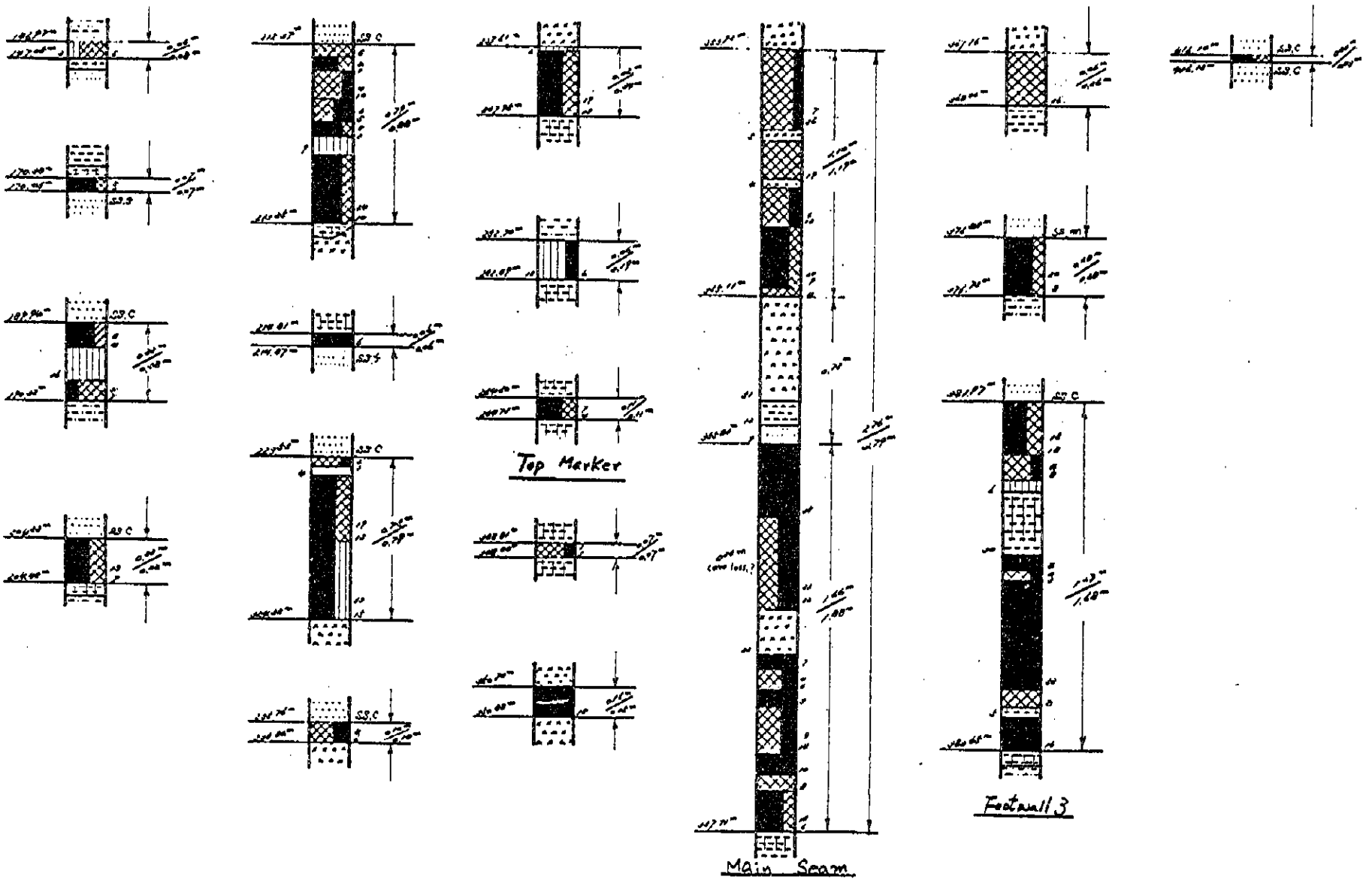


Footwall 3

DD 51.

S = 1 : 20

Figure 11 Columnar Coal Section of DD51



4）Long Space Density （LSD）

5）Bed Resolution Density （BRD）

1.7 地表調査

本年度は調査地域の東部及び南部の地表地質調査を行ったが、露頭は殆んどみられなかった。また、岩相対比の為、エッカ統上位のボウフォルト統及びモルテノ層の調査も行ったが、露出状況が悪く、一部露頭（モルテノ層に属すと思われる）でみられる砂岩はエッカ統の砂岩よりも粗粒で石英質であることを確認した。

1.8 石炭及び岩石の試料採取

石炭の分析はスリジランド側で行うが、クロスチェックの為に本調査団も17試料を採取した。その内訳は次のとおりである。

Main Seam	DD4	2試料
	DD13	1 〃
	DD25	2 〃
	DD29	2 〃
	DD38	1 〃
	DD50	2 〃
	DD51	2 〃
Intermediate Marker Seam	DD25	1 〃
	DD38	1 〃
	DD49	1 〃
Footwall 〃3 Seam	DD13	1 〃
	DD25	1 〃

この他に鉱物組成分析用としてドレライト4試料、砂岩1試料を採取した。

2 試 錐 作 業

2.1 掘削作業

掘削作業は当初試錐機4台（SECO 50 1台、JOYSULLIVAN D26 3台）で開始したが、11月半ばに試錐機2台（TONE TOM、ATLAS COPCO B50）を追加した。この内、ATLAS COPCO B50は主として風化帯のノン・コアリング掘削に使用し、他の試錐機は全てワイヤライン工法によるコアリング掘削を行った。

各試錐孔共、地表の風化帯（20～40m）は崩壊を避けるため110㎜及び89㎜のケーシングをセットした。掘削は主としてエア・フラッシュ工法で行い、89㎜ケーシングのセットにはNXCダイヤモンド・ビット（φ＝90㎜）を使用した。それ以深の掘削には主としてNQダイヤモンド・ビット（φ＝75.7㎜）を用い、一部TNWダイヤモンド・ビット（φ＝88㎜）を使用した。

尚、昨年度中断した3孔の継続掘削は、DD10孔が297mまでNQケーシングをセットした為、BQダイヤモンド・ビット（φ＝59.9㎜）を使用して掘削した。又、DD8、DD48の2孔については切断して孔内に残留したロッド及びコア・バーレルの回収に努力したが成功せず、ウェッジを使用して孔曲げ掘削を行った。尚、DD8はドレライトが軟弱の為にNQケーシングを挿入し、310.07mからBQビットを使用した。

コア回収率は各試錐孔ともに99%前後と良好であり、地質及び炭層状況の観察に充分役立てる事が出来た。

2.2 試錐工事実績

試錐工事は昭和56年8月28日から開始し、同57年2月17日合計22試錐孔（昨年度中断した3試錐孔の継続含む）、総掘削長7,835.22m（DD51A孔3mを含む）をもって終了した。使用試錐機毎の掘削状況を第12図に、各試錐孔の工事実績概要を第1表に示す。

DD51孔は孔内状況悪く逸水激しいので、ケーシングを順次増長したが53.93mで孔曲りの為にケーシング抜管できず、試錐位置を1m東に移動して掘直した。本孔は試錐業者の不注意によるものと判断し、スワジランド政府／試錐下請業者間の契約に基づき、DD51A孔の掘削実績長は3.00mとした。

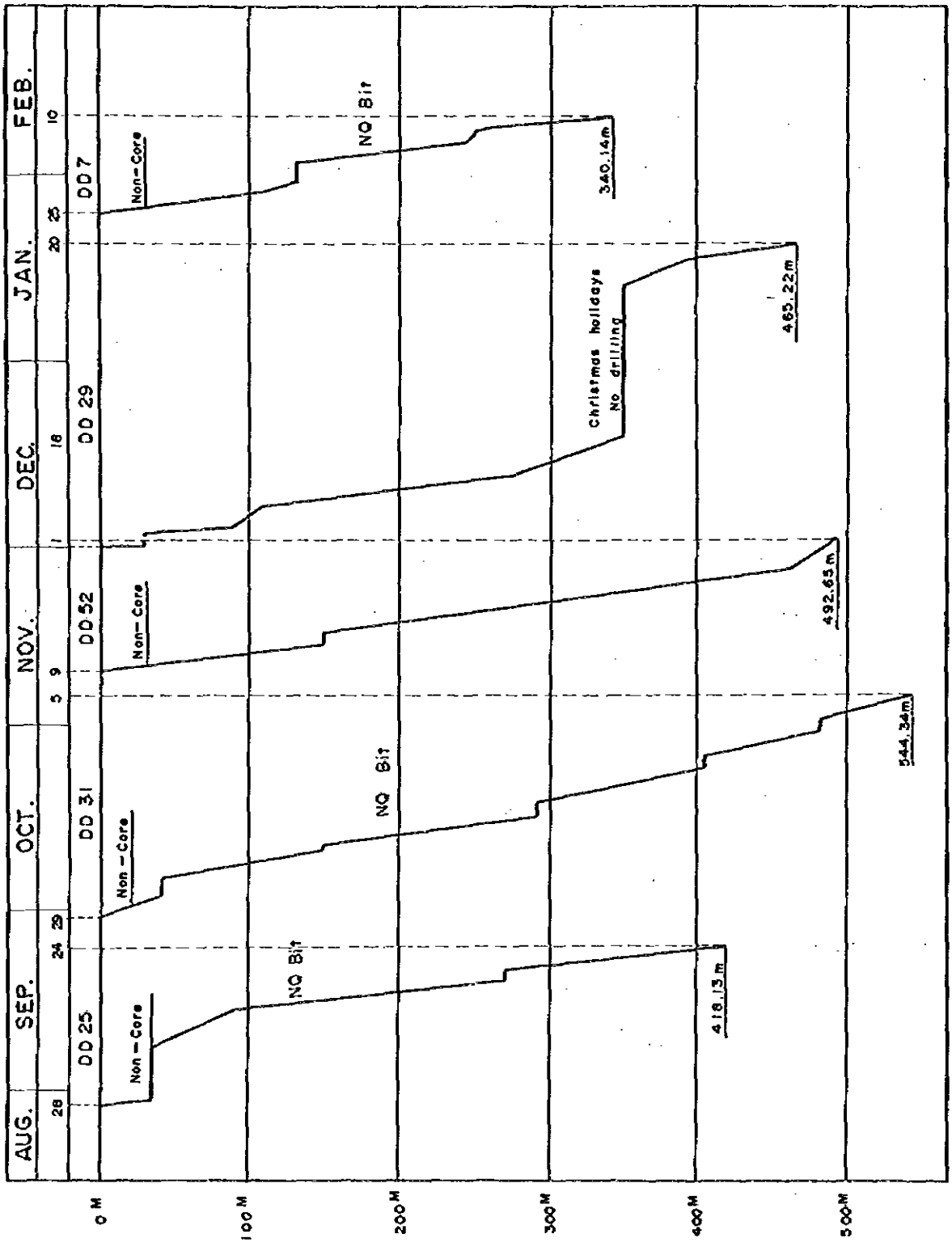


Figure 12-1 Execution Process of Drilling Operation

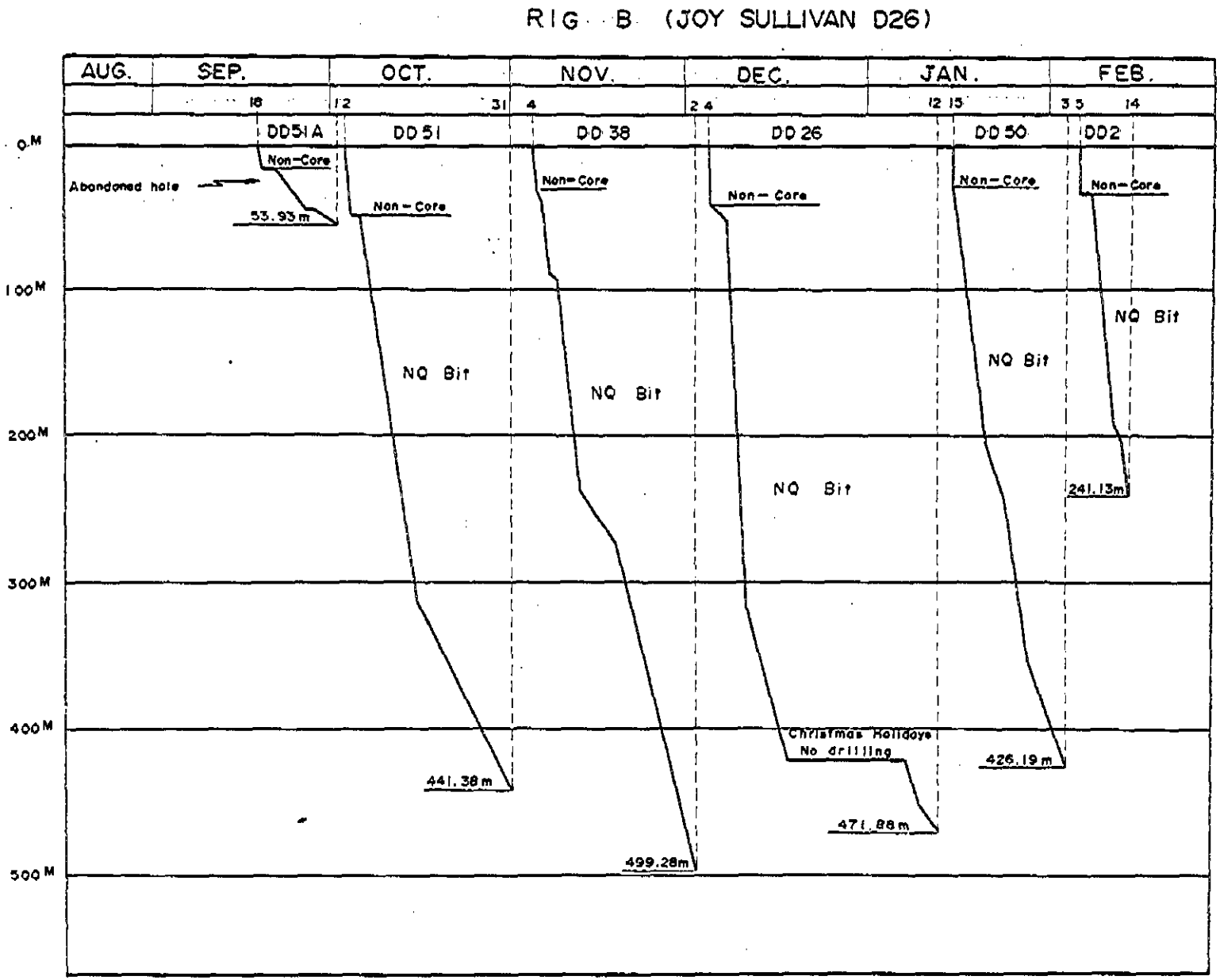


Figure 12-2 Execution Process of Drilling Operation

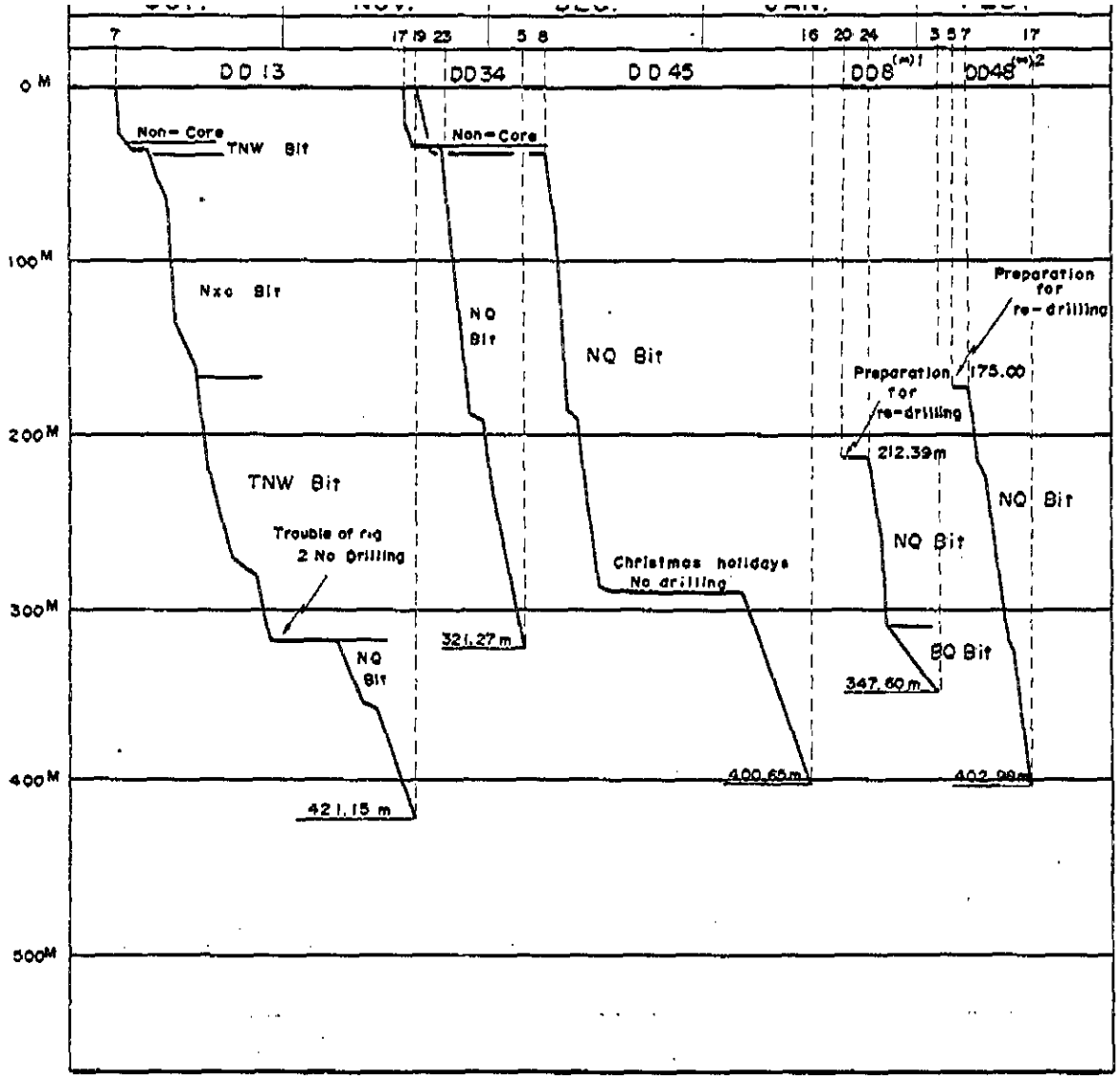


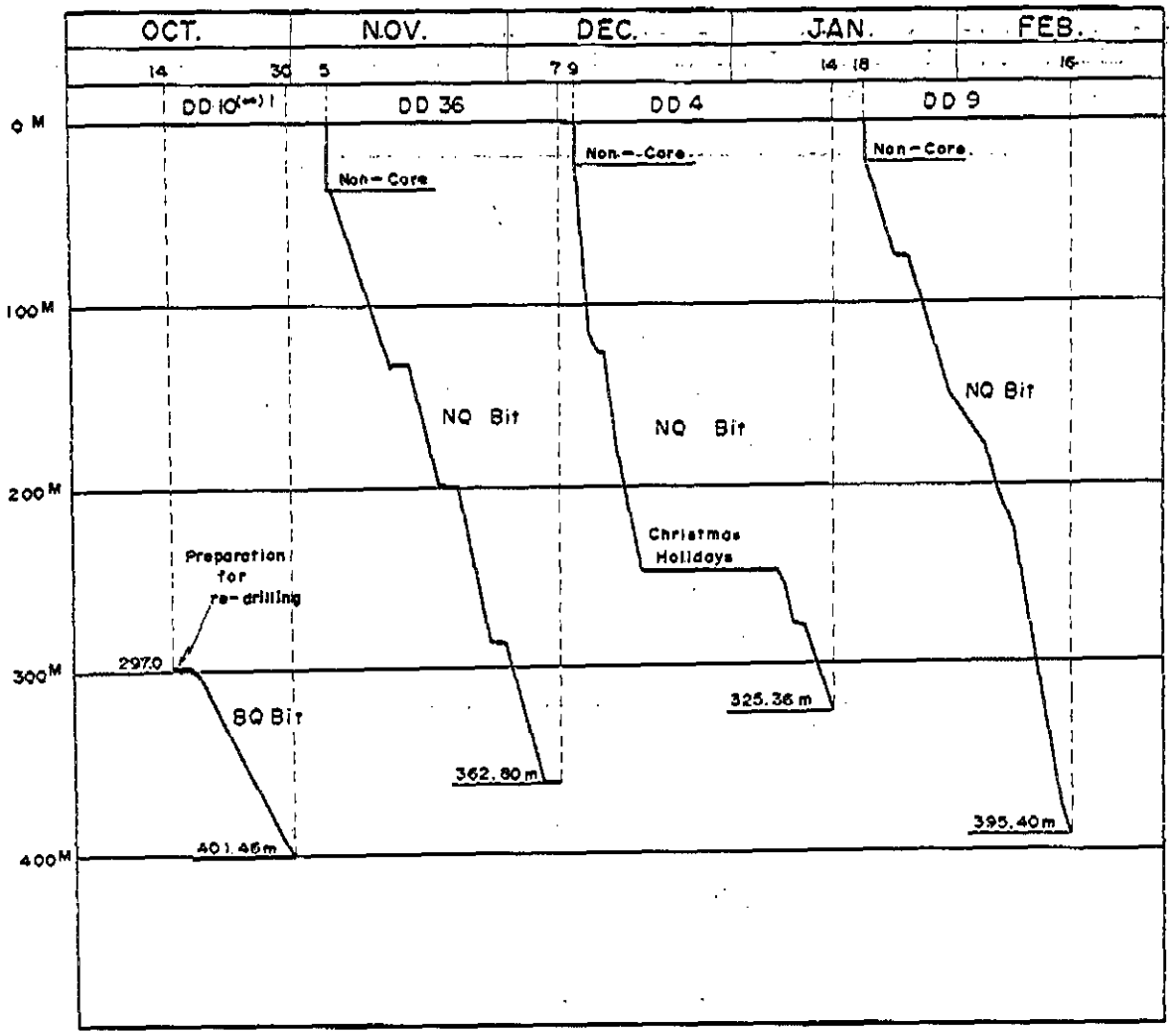
Figure 12-3

Execution Process of Drilling Operation

(*)1 DD8 hole had been discontinued in Phase I at the depth of 295.50 M, and was re-drilled in Phase II from the depth of 212.39 M using a wedge.

(*)2 DD48 hole had also been discontinued in Phase I at the depth of 316.20 M, and was re-drilled in Phase II from the depth of 175.00 m using a wedge.

RIG D (JOYSULLIVAN D26)



(*) 1. DD 10 hole had been discontinued in Phase I at the depth of 297.00 M and was continued to drill from the depth of 297.00 M in Phase II.

Figure 12-4 Execution Process of Drilling Operation

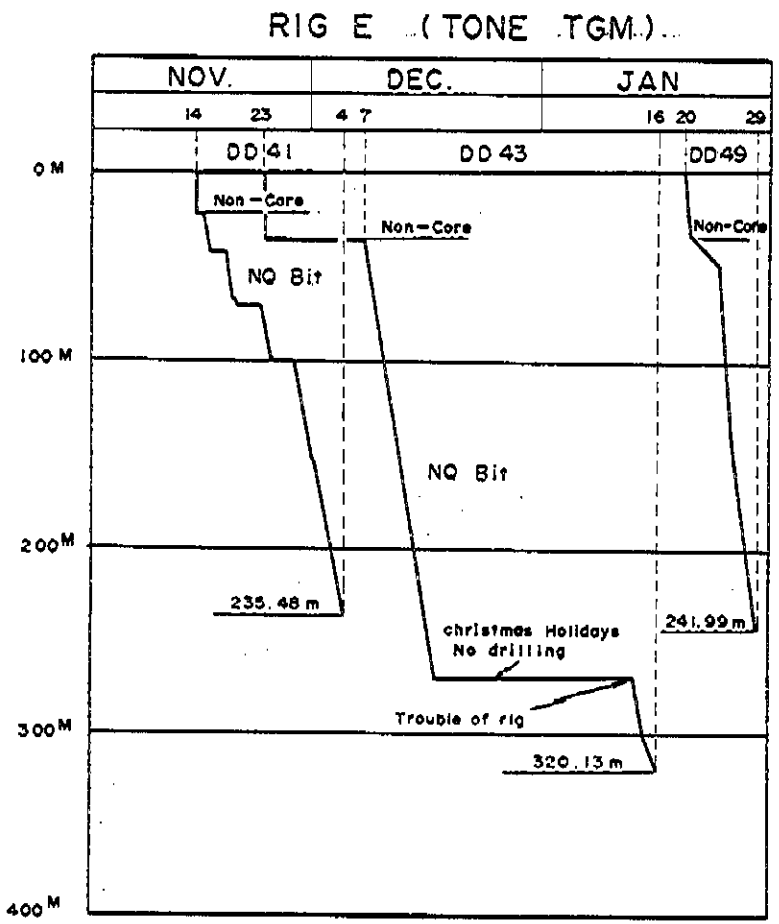


Figure 12-5 Execution Process of Drilling Operation

Table 1 — 1. Drilling Record

	DD25	DD51	DD31	DD13	DD38	DD36	DD52	DD41	DD34	DD29	DD26
Operating Period	28/8 1981 ~ 24/9 1981	2/10 1981 ~ 31/10 1981	29/9, 1981 ~ 5/11, 1981	7/10, 1981 ~ 19/11, 1981	4/11, 1981 ~ 2/12, 1981	5/11, 1981 ~ 7/12, 1981	9/11, 1981 ~ 1/12, 1981	4/11, 1981 ~ 4/12, 1981	18/11, 17/11 1981 23/11, 1981 ~ 5/12, 1981	30/11, 1981 3/12, 1981 ~ 20/1, 1982	4/12, 1981 ~ 12/1, 1982
Actual operating days	16	25	27	29	23	26	19	12	14	21	18
Coordinate X	+2,929,000	+2,935,000	+2,937,000	+2,937,000	+2,939,000	+2,939,000	+2,935,000	+2,941,000	+2,939,000	+2,933,000	+2,929,000
Coordinate Y	− 79,754	− 78,001	− 80,000	− 78,200	− 80,950	− 79,000	− 80,000	− 77,070	− 77,450	− 80,810	− 81,050
Elevation(m)	+271.3	+266.0	+250.0	+248.7	+232.0	+250.0	+261.8	+272.3	+276.9	+238.0	+260.5
Final drilling length	418.13	441.38	544.34	421.15	499.28	362.80	492.65	235.48	321.27	465.22	471.88
Planned drilling length	400	455	490	395	445	350	520	130	265	460	475
Coring interval(m)	35.19 ~418.13	14.60 ~441.38	21.00 ~544.34	31.64 ~421.15	29.08 ~499.28	36.00 ~362.80	29.30 ~492.65	41.70 ~235.48	34.00 ~321.27	28.82 ~465.22	38.59 ~471.88
Core recovery(%)	100	99	99	100	100	100	99	100	100	100	99
Remarks		＊1									

＊1. The first hole was abandoned at the depth of 53.93 M because of hole bending

Table 1 — 2. Drilling Record

	DD43	DD45	DD4	DD50	DD9	DD49	DD7	DD2	DD10	DD8	DD48
Operating Period	23/11 1981 ~ 16/1 1982	19/11~20/11 1981, 8/12 1981 ~ 16/1 1982	9/12 1981 ~ 14/1 1982	15/1 1982 ~ 3/2 1982	18/1 1982 ~ 16/2 1982	20/1 1982 ~ 29/1 1982	25/1 1982 ~ 10/2 1982	5/2 1982 ~ 14/2 1982	14/10 1981 ~ 30/10 1981	21/1 1982 ~ 3/2 1982	8/2 1982 ~ 17/2 1982
Actual operating days	13	18	16	17	24	9	13	8	12	9	10
Coordinate X	+2,941.000	+2,941.000	+2,929.000	+2,931.000	+2,932.900	+2,931.000	+2,933.000	+2,929.020	+2,934.650	+2,932.800	+2,930.841
Coordinate Y	− 78.790	− 80.860	− 79.000	− 80.000	− 79.000	− 77.000	− 77.000	− 76.983	− 76.720	− 78.000	− 78.541
Elevation(m)	+280.2	+249.1	+260.6	+251.4	+248.9	+277.0	+270.0	+292.5	+266.2	+252.8	+275.3
Final drilling length	320.13	400.65	325.36	426.19	395.40	241.99	340.14	241.13	401.46	347.60	402.98
Planned drilling length	275	370	320	300	385	290	370	205	397	365	406
Coring interval(m)	35.00 ~320.13	34.00 ~400.65	23.43 ~325.36	26.73 ~426.19	23.20 ~395.40	34.81 ~241.99	28.55 ~340.14	33.10 ~241.13	22.55 ~401.46	9.15 ~347.60	17.92 ~402.98
Core recovery(%)	99	100	100	99	100	99	99	99	94	99	100
Remarks									＊1	＊2	＊3

＊1.: This hole had been discontinued at the depth of 297.00 m in the Phase Ⅰ and was continued to drill from the depth of 297.00 m in the phase Ⅱ.

＊2.: This hole had been discontinued at the depth of 295.50 m in the Phase Ⅰ.In the Phase Ⅱ,this hole was re — opened from the depth of 212.39 m using a wedge.

＊3 : This hole had been discontinued at the depth of 316.20 m in the Phase Ⅰ.In the Phase Ⅱ,this hole was re — opened from the depth of 175.00 m using a wedge.

昨年度中断した３孔の内、ＤＤ１０孔は孔底に溜ったスライム、岩片の排除に多少の困難を伴ったが昨年度の孔底２９７ｍからＮＱケーシングをセットし、ＢＱビットにより掘削継続が出来た。ＤＤ４８孔は本工期初めに孔底のスライム、岩片排除を試みたが、ジャミングによるロッドの切断事故が発生し、孔内に残留したロッド２２本及びコア・バーレルの回収に種々努めたが成功せず、一旦工事を中断した。その後、ウェッジ使用による孔曲げ掘削を行い計画深度で終了した。ウェッジのセッティング深度は１７５.００～１７９.２０ｍで、コアリングは１７７.７０ｍより行った。孔曲げ角度は１° ０５′である。ＤＤ８孔は昨年度のロッド切断事故で孔内に残留したロッド５本とコア・バーレルの回収に努めたが成功せず、ウェッジ使用による孔曲げ掘削を実施した。ウェッジのセッティング深度は２１２.３９～２１６.５４ｍで、コアリングは２１５.５９ｍから開始した。孔曲げ角度は１° ０５′である。

本年度の試錐工事も雨季（１１月～２月）にかゝる為、昨年度の苦い経験に鑑み資材、用水運搬用としてトラクター３台を搬入する等充分の対策を講ずると共に、工事の迅速化を図る為に各試錐孔ともワイヤライン工法で掘削し、操業は当初から一日２方とした。工事量は当初計画より約６７５ｍの増加となったが、天候にも恵まれほゞ計画期限内に工事を完了することが出来た。

3 調 査 結 果

3.1 炭層状況

調査地域東部のＤＤ２６、ＤＤ２９、ＤＤ５０の３孔は中部エッカ統の上に重なる上部エッカ統のUpper Coal Zone の中部から下部にかけた層準から掘削を開始し、Upper Coal Zoneの炭層賦存状況も確認することが出来た。残りの試錐孔は全て中部エッカ統のUpper Transition Beds乃至Upper Sandstone の層準から掘削を開始した。

全試錐孔ともLower Coal Zoneの最下部或いはその下位Basal Sandstone の最上部層準まで掘削したが、主要炭層であるMain Seamを捕捉したのは１５孔である。ＤＤ３１、ＤＤ３６の２孔は断層によりMain Seamを確認できず、ＤＤ２６、ＤＤ５２の２孔はドレライトの貫入によりMain Seamが欠層していると判断される。ＤＤ９、ＤＤ３４、ＤＤ４５の３孔は厚いドレライトに遭遇しMain Seamは捕捉できず、確認した炭層数も少なく、地層の対比は困難である。

現在までの調査結果をみると、Main Seamは調査地域の北部から中部にかけて良く発達しており、炭層も2.0～4.7ｍと厚層である。しかし、東部（ＤＤ２６、ＤＤ５０、ＤＤ２９付近）ではMain Seamが分層する傾向がみられる。一方、南部ではドレライトが厚く発達し、Main Seamに着炭したのはＤＤ１３、ＤＤ３８、ＤＤ４１、ＤＤ４３の４孔のみで、層厚も１～２ｍと北部に比べて薄層であり、更にドレライトの影響で焼きつきを起している。

他の主要炭層であるIntermediate Marker Seam、Footwall №3 Seam についてもその発達状況はMain Seamと同様に南部よりも北部の方が良好である。

各試錐孔における主要炭層グループ（Top Marker、Intermediate Marker、Main Seam、Footwall №3）の着炭深度を第２表に示す。

3.2 ドレライト

昨年度の調査結果から予想した様に、特に南部ではドレライトの貫入が著るしく、厚い粗粒のドレライト・シル及び岩脈が広範囲にわたって複雑に貫入しており、炭層の賦存に大きな影響を与えている。一方、北部でもドレライトの貫入が各試錐孔でみられるが、一般に岩休は小規模であり、厚いシルは部分的にみられるのみである。

Table 2 — 1. Thickness of Coal Seams

		DD2	DD4	DD25	DD26	DD49	DD50	DD7	DD9	DD29	DD51	DD52
	Height of Collar(m)	+292.5	+260.6	+271.3	+260.5	+277.0	+251.4	+270.0	+248.9	+238.0	+266.0	+261.8
TOP MARKER	Deapth to Seam(m)	157.76	231.88	334.62	381.23	156.86	352.67	256.18		385.90	264.60	279.82
	Seam thickness	0.42	0.33	0.36	0.24	0.39	0.35	0.55	—	0.20	0.11	0.50
	Coal thickness	0.42	0.18	0.36	0.24	0.39	0.22	0.55		0.20	0.11	0.40
INTERMEDIATE MARKER	Deapth to Seam(m)	164.33	239.34	341.87	388.15	164.97	359.72	262.45		391.40		287.19
	Seam thickness	1.58	1.54	1.53	1.08	1.73	1.35	1.25	—	1.37	—	0.96
	Coal thickness	1.58	1.54	1.53	0.83	1.73	1.35	1.25		0.50		0.73
BOTTOM MARKER	Deapth to Seam(m)	172.80	247.95	351.55		173.19	366.61	271.50		398.45		
	Seam thickness	0.55	0.41	0.42	—	0.50	0.43	0.51	—	0.35	—	—
	Coal thickness	0.55	0.41	0.42		0.50	0.43	0.18		0.35		
MAIN SEAM	Deapth to Seam(m)	202.43	266.58	364.45		190.22	386.54	294.94		412.69	353.92	
	Seam thickness	1.67	4.70	3.87	—	4.65	3.83	2.34	—	3.93	3.79	—
	Coal thickness	1.03	3.72	3.36		4.30	2.81	2.34		2.15	2.76	
FOOTWALL3 SEAM	Deapth to Seam(m)	216.78	289.33	387.83		219.07		318.53		452.62	381.97	
	Seam thickness	1.14	1.07	0.69	—	1.23		1.09	—	1.38	1.68	—
	Coal thickness	1.10	0.97	0.69		1.08		0.62		0.97	1.29	

Table 2 – 2 Thickness of Coal Seams

		DD13	DD31	DD34	DD36	DD38	DD41	DD43	DD45	DD48	DD8	DD10
	Height of Collar (m)	+248.7	+250.0	+276.9	+250.0	+232.0	+272.3	+280.2	+249.1	+275.3	+252.8	+266.2
TOP MARKER	Deapth to Seam (m)	305.20	344.90		250.17	411.94	84.74	231.70		321.78	221.07	
	Seam thickness	0.65	0.12	–	0.19	0.57	0.13	0.58	–	0.04	0.34	–
	Coal thickness	0.57	0.02		0.06	0.24	0.13	0.20		0.04	0.34	
INTERMEDIATE MARKER	Deapth to Seam (m)	319.87	367.85			418.31	*1 98.94				230.23	
	Seam thickness	0.52	0.40	–	–	1.18	0.73	–	–	–	1.43	–
	Coal thickness	0.52	0.40			1.18	0.34				1.43	
BOTTOM MARKER	Deapth to Seam (m)	324.96	378.48			424.16						
	Seam thickness	0.10	0.02	–	–	0.20	–	–	–	–	–	–
	Coal thickness	0.10	0.02			0.20						
MAIN SEAM	Deapth to Seam (m)	334.21				439.37	109.87	238.30		324.50	302.70	
	Seam thickness	2.09	–	–	–	1.99	1.15	1.20	–	1.36	2.11	*2 1.26+
	Coal thickness	1.95				1.75	0.63	1.16		1.07	2.11	0.35+
FOOTWALL 3 SEAM	Deapth to Seam (m)	384.69					134.67	268.41		341.54	324.23	
	Seam thickness	1.04	–	–	–	–	0.97	0.74	–	1.08	1.10	
	Coal thickness	0.95					0.83	0.64		1.08	1.05	

*1 Not certified

*2 Not certified because of core loss

4 国内解析

本年度の国内解析は昨年度の調査資料に基づいて行ったが、昨年度の試錐が調査対象地域の北部に限定され、且つ試錐本数が少ない為、解析作業用の資料としては不充分なので詳細については今後の解析作業を待って報告する。

現在までに行った解析の結果、明らかになった点を次に述べる。

4.1 物理検層

昨年度実施した6孔の物理検層の結果をみると、炭層及びドレライトについては下記の如き特性を示している。

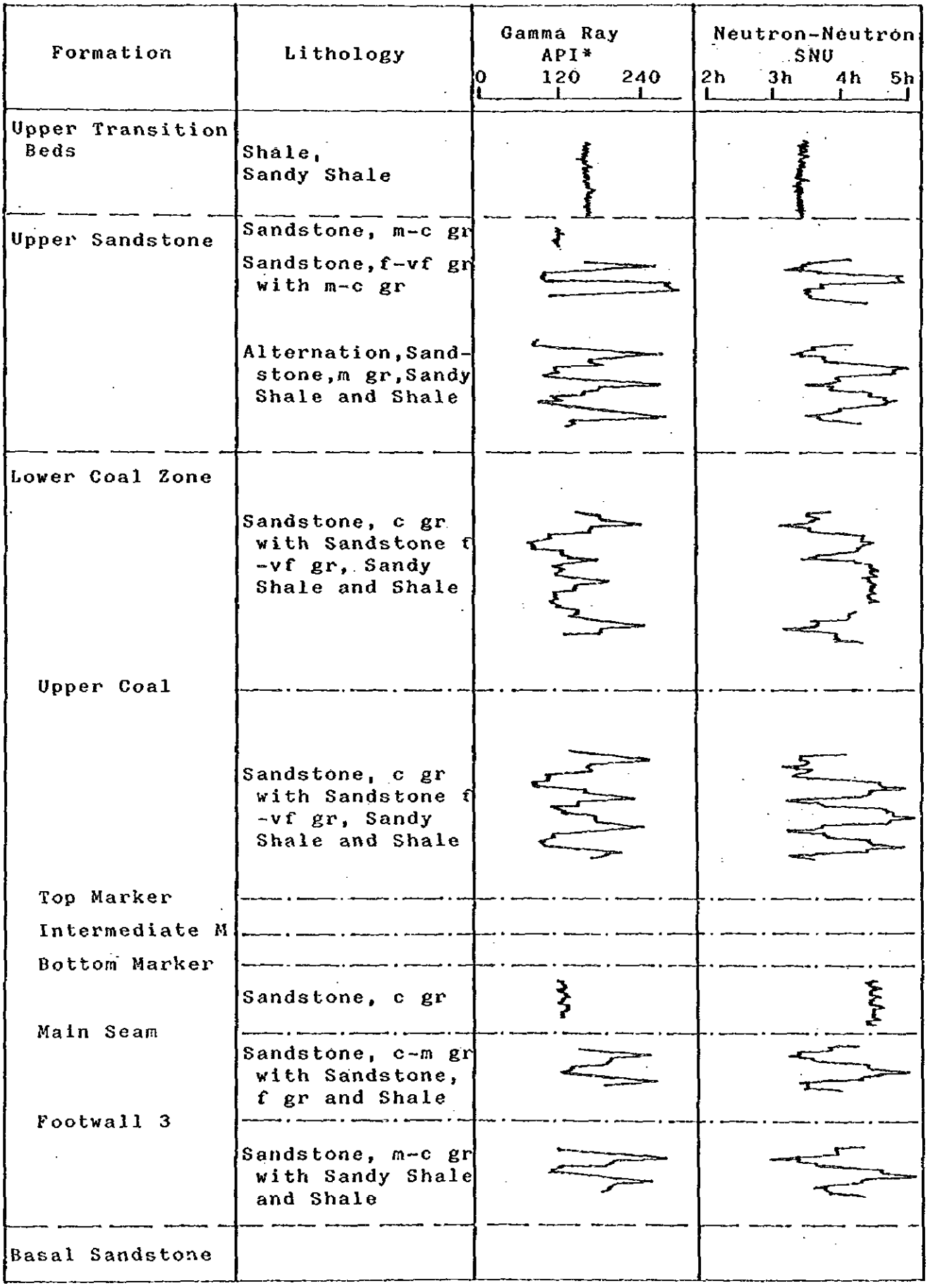
炭　　層	ガンマー線：非常に低い値	
	密度検層	：LSD、BRDともに非常に小さい値、一般に1.7 g/cm以下
	中性子検層：非常に低い値	
ドレライト	ガンマー線：非常に低い値	
	密度検層	：LSD、BRDともにかなり大きい値
	中性子検層：安定した中位～やゝ高い値	

一方、ガンマー線とニュートロン－ニュートロンの複合検層が中部エッカ統の特定の層準で次のような特性を示している。

層　準	検　層　特　性
Upper Transition Beds 最下部	ガンマー線：安定したやゝ高い値 中性子検層：安定した中位の値
Upper Sandstone 最上部	ガンマー線：特徴的なプロファイル
Upper Coal Seam の上	中性子検層：安定したやゝ高い値
Main Seam の直上	ガンマー線：安定した中位の値 中性子検層：安定したやゝ高い値

上述の如く炭層及びドレライトの識別並びに中部エッカ統の層準対比方法として、物理検層は有用な手段であることが分った。中部エッカ統の模式的な物理検層特性を第13図に示す。

Figure 13. Type Profile of Geophysical Logging in the Middle Ecca Series, Lubhuku Area.



Remarks: * Hole size corrected.

4.2 石炭試料分析

クロス・チェックの為、昨年度採取した石炭コア試料（原炭）7個の分析結果を第3表に示す。尚、試料は炭層中の夾みも含めてコア・スプリッターで2分割し、また炭層が厚い場合には2個以上に分けて試料採取した。

1）工業分析

無水無灰ベースの炭質を次に示す。

試料No.	DD5			DD6		DD5	DD3
炭層	Main Seam (1)	Main Seam (2)	Main Seam (3)	Main Seam (1)	Main Seam (2)	Intermediate Marker	Footwall No.3
発熱量 (Kcal/Kg)	8,168	8,408	8,547	8,424	8,526	8,363	8,176
固定炭素 (%)	84.5	86.6	87.4	84.9	85.5	87.4	84.6
揮発分 (%)	15.5	13.4	12.6	15.1	14.5	12.6	15.4

ASTMの分類によるとDD5孔のMain Seamの炭質は半無煙炭であり、DD6孔のそれは低揮発分瀝青炭である。又、DD5孔のIntermediate Markerは半無煙炭に、DD3孔のFootwall No.3は低揮発分瀝青炭に分類される。尚、Main Seamは他の炭層と比べると発熱量がやゝ高い傾向がみられる。

2）元素分析

元素分析の結果と石炭化度との関係を第14～16図に示す。各炭層とも多少ばらついた分布をしている。

3）組織分析

第4表に組織分析の結果を示す。各炭層ともにイナーチィニット、特にミクリニットの多いのが特徴である。

4.3 検鏡試験

1）ドレライト

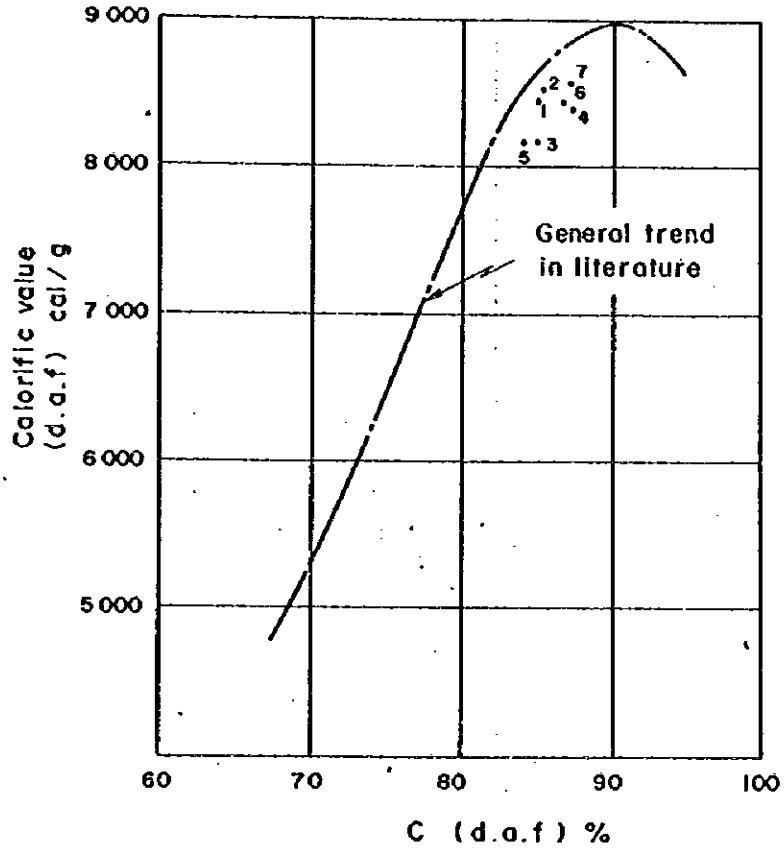
カルー系中には「カルー・ドレライト」と称する暗色結晶質火成岩が地層面に平行なシル、地層面と斜交するシル及び岩脈として広範囲にわたって貫入している。これら貫入岩は大陸地域にみられる典型的なソレアイト質玄武岩である。

Table 3 Results of coal analysis and testing

Hole Number		DD3	DD5				DD6	
Coal Seam		Footwall 3	Intermediate Marker	Main Seam (1)	Main Seam (2)	Main Seam (3)	Main Seam (1)	Main Seam (2)
Depth		261.15~263.03	139.29~141.35	162.97~164.92	164.92~166.91	166.91~167.96	284.77~286.18	286.18~288.50
Proximate Analysis (%)	Total Moisture	1.4	2.2	2.5	2.2	2.4	1.2	1.5
	Inherent Moisture	1.1	1.2	1.4	1.2	1.2	1.2	1.3
	Ash	35.3	19.4	45.1	15.9	10.7	22.0	11.2
	Volatile Matter	9.8	10.0	8.3	11.1	11.1	11.6	12.7
	Fixed Carbon	53.8	69.4	45.2	71.8	77.0	65.2	74.8
Total Sulfur		3.6	0.5	0.2	0.4	0.5	0.4	0.4
Calorific Value (cal/g)		5,200	6,640	4,370	6,970	7,530	6,470	7,460
C. S. N		0	0	0	0	0	0	0
Specific Gravity		1.75	1.55	1.79	1.49	1.46	1.55	1.47
Hardgrove Grindability Index		63	65	70	62	62	70	73
Ultimate Analysis (%)	C	56.5	73.4	49.1	75.8	80.6	70.0	80.6
	H	2.4	3.1	2.3	3.2	3.8	3.3	3.6
	N	1.3	1.6	1.3	1.8	2.0	1.7	2.0
	O	0.8	1.9	1.3	2.9	2.4	2.6	2.2
	Mineral Matter	35.6	19.6	45.8	16.1	10.8	22.2	11.4
	Combustible Sulfur	3.4	0.4	0.2	0.2	0.4	0.2	0.2
Ash (℃) fusimpoint	Deformation	1,280	1,250	1,380	1,290	1,300	1,400	1,290
	Hemisphere	1,410	1,290	1,450+	1,340	1,340	1,450+	1,330
	Flow	1,420	1,310	1,450+	1,360	1,390	1,450+	1,400
Ash Analyses (%)	SiO_2	44.66	59.96	64.04	51.33	47.89	59.17	45.26
	TiO_2	1.15	0.95	1.15	1.03	1.25	1.66	0.97
	Al_2O_3	24.58	19.13	24.72	26.16	26.16	27.05	21.52
	Fe_2O_3	19.16	7.62	2.25	6.69	7.41	3.23	14.14
	MgO	0.93	2.03	0.97	1.93	2.33	0.79	2.29
	CaO	2.83	6.11	1.55	7.63	9.36	4.86	9.80
	Na_2O	0.47	0.32	0.45	0.74	0.70	0.37	0.23
	K_2O	4.20	3.05	3.95	2.22	2.19	0.67	0.42
	P_2O_5	0.07	0.11	0.08	0.06	0.06	0.09	0.07
	SO_3	1.56	0.67	0.41	1.84	2.25	1.86	5.20

* Analysed on air dry basis
* Analysed by Tokyo Coal and Mineral Research Institute

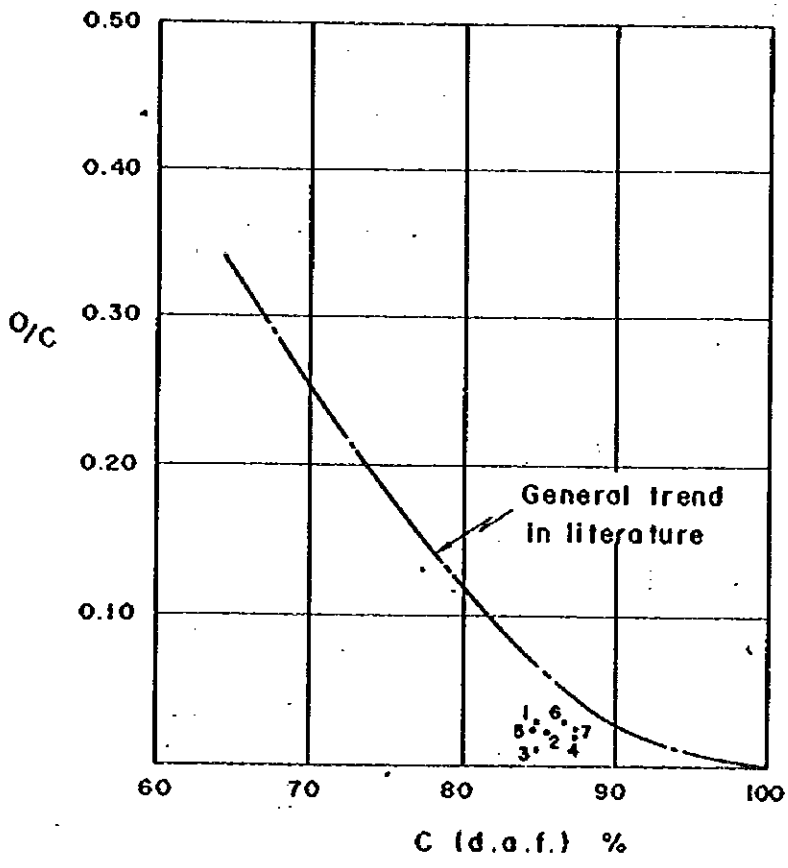
FIGURE 14 THE RELATION BETWEEN CALORIFIC VALUES AND CARBON CONTENTS (d. a. f.)



(Remarks)

1 : DD6 Main seam(1)
2 : DD6 Main seam(2)
3 : DD3 Footwall 3
4 : DD5 Intermediate marker
5 : DD5 Main seam(1)
6 : DD5 Main seam(2)
7 : DD5 Main seam(3)

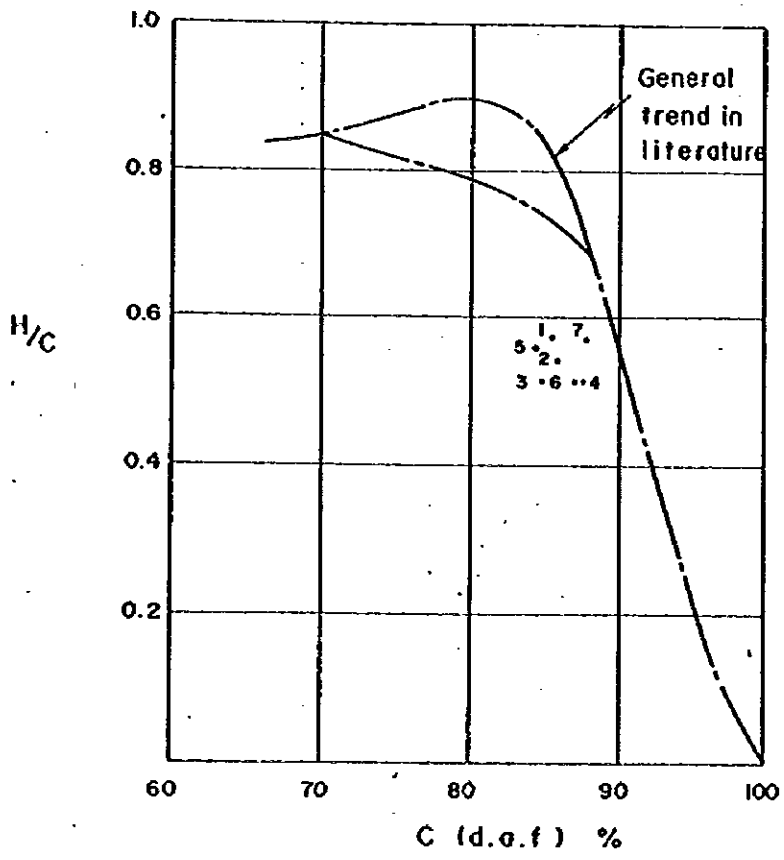
FIGURE 15 THE RELATION BETWEEN O/C RATIOS (in number of atoms) AND CARBON CONTENTS (d.a.f.)



(Remarks)

1 : DD6 Main seam(1)
2 : DD6 Main seam(2)
3 : DD3 Footwall 3
4 : DD5 Intermediate marker
5 : DD5 Main seam(1)
6 : DD5 Main seam(2)
7 : DD5 Main seam(3)

FIGURE 16 THE RELATION BETWEEN H/C RATIOS (In number of atoms) AND CARBON CONTENTS (d.a.f.)



〔Remarks〕

1 : DD6 Main seam(1)
2 : DD6 Main seam(2)
3 : DD3 Footwall 3
4 : DD5 Intermediate marker
5 : DD5 Main seam(1)
6 : DD5 Main seam(2)
7 : DD5 Main seam(3)

Table 4 - 1

Petrographic Analysis

Sample		DD6-1	DD6-2	DD5-Inter
Vitrinite Type vol%	V 19	1.4	-	-
	V 20	18.9	2.6	-
	V 21	22.2	18.1	3.9
	V 22	3.7	32.4	16.7
	V 23	-	11.6	20.6
	V 24	-	-	7.8
	V			
	V			
	V			
	V			
	V			
	V			
Maceral vol%	Vitrinite	47.1	66.8	49.0
	vitrinite	46.2	64.7	49.0
	pseudovitrinite	0.9	2.1	-
	Exinite	-	-	-
	exinite	-	-	-
	resinite	-	-	-
	Inertinite	46.0	28.7	43.8
	micrinite	14.7	8.7	18.9
	semifusinite	28.6	19.5	24.7
	fusinite	2.7	0.5	0.2
	Mineral Matter	6.9	4.5	7.2
Mean Maximum Reflectance %		2.10	2.25	2.32
Reactive Entity vol%		56.0	71.9	57.2
Inert Entity vol%		44.0	28.1	42.8
Composition Balance Index		Not calculated	Not calculated	Not calculated
Strength Index		〃	〃	〃
Calculated Coke Strength		0	0	0

Remarks

DD6 - 1 Main Seam ($284.^{77}$ - $286.^{18}$M)

DD6 - 2 Main Seam ($286.^{18}$ - $288.^{50}$M)

DD5 - Inter Intermediate Marker ($139.^{29}$ - $141.^{35}$M)

Table 4 - 2
Petrographic Analysis

Sample		DD5-1	DD5-2	DD5-3
Vitrinite Type vol%	V 19	-	-	-
	V 20	-	-	1.5
	V 21	-	7.9	11.9
	V 22	26.3	48.8	49.3
	V 23	25.2	3.6	12.0
	V 24	-	-	-
	V			
	V			
	V			
	V			
	V			
	V			
Maceral vol%	Vitrinite	51.5	61.8	75.9
	vitrinite	51.5	60.3	74.7
	pseudovitrinite	-	1.5	1.2
	Exinite	-	-	-
	exinite	-	-	-
	resinite	-	-	-
	Inertinite	35.8	33.5	23.0
	micrinite	25.1	18.6	14.9
	semifusinite	9.5	14.1	7.5
	fusinite	1.2	0.8	0.6
	Mineral Matter	12.7	4.7	1.1
Mean Maximum Reflectance %		2.29	2.24	2.24
Reactive Entity vol%		54.7	65.5	77.6
Inert Entity vol%		45.3	34.5	22.4
Composition Balance Index		Not calculated	Not calculated	Not calculated
Strength Index		〃	〃	〃
Calculated Coke Strength		0	0	0

Remarks

DD5 - 1 Main Seam ($162.^{97}_{92}$ - $164.^{92}_{91}$M)
DD5 - 2 Main Seam ($164.^{91}_{}$ - $166.^{96}_{}$M)
DD5 - 3 Main Seam ($166.^{}_{}$ - $167.^{}_{}$M)

Table 4-3
Petrographic Analysis

Sample		DD3-Foot		
Vitrinite Type vol%	V 19	-		
	V 20	-		
	V 21	-		
	V 22	-		
	V 23	0.7		
	V 24	10.3		
	V 25	44.1		
	V 26	13.8		
	V			
	V			
	V			
	V			
Maceral vol%	Vitrinite	70.4		
	vitrinite	68.9		
	pseudovitrinite	1.5		
	Exinite	-		
	exinite	-		
	resinite	-		
	Inertinite	22.1		
	micrinite	16.2		
	semifusinite	5.9		
	fusinite	-		
	Mineral Matter	7.5		
Mean Maximum Reflectance %		2.55		
Reactive Entity vol%		71.4		
Inert Entity vol%		28.6		
Composition Balance Index		Not calculated		
Strength Index		"		
Calculated Coke Strength		0		

Remarks

DD3 - Foot Footwall 3 Seam ($261.^{15}$ - $263.^{03}$M)

検鏡試験の結果、岩脈及び薄いシルでは中心部がドレライト又は玄武岩で周縁部では細粒の玄武岩に変っており、厚いシルでは中心部が斑糲岩質岩石又はドレライトで周縁部では玄武岩に移行する事が判明した。

鏡下で観察されるドレライトの岩石学的特徴を第5表に示す。

第 5 表　　ドレライトの岩石学的特徴

産状	部分	組織	構成鉱物
薄いシル及び岩脈	接触部	ガラス状	タキライトの細い黒褐色帯（3～5㎜）
	周縁部	斑状、玄武岩状	輝石、針長石マイクロライトから成るメソスタシスヌは細粒石基中に橄欖石、輝石の斑晶
	中心部	オフィチック、玄武岩状	粒状輝石、短冊状斜長石の石基中に輝石、橄欖石の斑晶
厚いシル	接触部	ガラス状	ガラス状石基中に斜長石、輝石小結晶から成る急冷周縁相（4～6㎜）。直接接触部に鉄酸化物から成る極細黒色帯（0.1㎜）
	周縁部	玄武岩状	短冊状斜長石（曹灰長石）、小粒状輝石の石基中に輝石、橄欖石、斜長石の斑晶
	中心部	完晶質、オフィチック	橄欖石、輝石の結晶を短冊状斜長石（亜灰長石－曹灰長石）が充す。若干の短冊状斜長石石基中に橄欖石、輝石、正長石、斜長石の結晶

ドレライトの岩脈及び厚いシルの代表的な顕微鏡写真を図版1、2に示す。

2）砂　　岩

中部エッカ統の砂岩は全層準にわたって構成鉱物、円磨度、粒子の淘汰等が殆んど類似しており、鏡下でも識別は難しい。いずれも花崗岩類、片麻岩類から由来した準アルコース～アルコースの大陸性堆積物である。

鏡下では石英が優勢で、正長石、斜長石、微斜長石を伴ない、少量の黒雲母、白雲母がこれらの粒間にみられる。粒度は一般に0.3～1.0㎜で殆んどの粒子が亜角状から亜円状であり、局部的に円状のものがみられる。粒子の淘汰は全般にやゝ悪いが局部的にやゝ淘汰の良いのもみられる。極く一部に重鉱物（柘榴石、ジルコン、燐灰石、磁鉄鉱

Plate 1. Photomicrographs of Dolerite Dyke

1. Contact of dyke and sandstone. Blackish brown zone of tachylite along the contact. DD10, 167.7m. open nicol, x85.

2. Marginal part of dyke. Porphyritic olivine-basalt. 17mm apart from the contact. DD10, 167.7m. open nicol, x85.

3. Central part of dyke. Olivine-basalt, coarse-grained. DD10, 161.6m. crossed nicol, x85.

Remarks:
Ol: olivine, Au: augite, Pl: plagioclase, Qt: quartz, Ga: garnet, Se: sericite, Ch: chlorite.

1.

2.

3.

Plate 2. Photomicrographs of Dolerite Sill

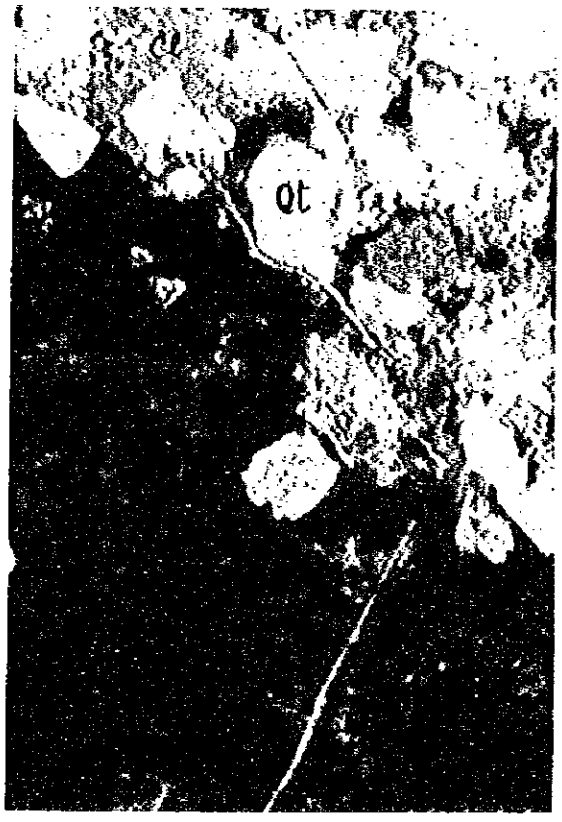
1. Contact of thicker sill and sandstone.
   Chilled margin, very narrow black band along the contact.
   DD6, 108.9m, open nicol, x85.

2. Marginal part of thicker sill.
   Tholeiitic basalt.
   DD6, 143.4m. open nicol, x85.

3. Central part of thicker sill.
   Tholeiitic dolerite, partly shows gabbroic.
   DD6, 128.3m. crossed nicol, x85.

Remarks.
   Ol: olivine, Au: augite,
   Pl: plagioclase, Qt: quartz.

1.



2.

3.

等）がみられるのみで、層序対比の手段として重鉱物は利用できない。

砂岩の代表的な顕微鏡写真を図版３に示す。

4.4　花粉分析

スワジランドのエッカ統からは僅かにGlossopterisの破片が報告されているだけであり、しかも産出は稀で保存が悪い。また、花粉分析は全く行なわれていない。南アフリカからザンビアにかけた南部アフリカの下部カルー系では花粉分析による地層対比に成果がみられるので、スワジランドにおける最初の試みとしてＤＤ３孔の炭質頁岩について花粉分析を行った。

試料は通常のシュルツェ液で処理したが花粉・胞子が得られず、残渣は殆んど炭化物なので、再度塩酸・弗化水素酸で処理した。その結果、Upper Sandstoneの中部から極く僅かであるが有翼型のDissacate型とみられる胞子の存在が認められた。保存状況が不良の為に詳細な同定は不可能であるが、この化石は二畳紀及びそれ以後の地層から産出している。又、三稜型及び単溝型とみられる胞子も２、３存在しているが、いずれも炭化しており詳細は不明である。図版４に代表的な有翼型胞子を示す。

花粉・胞子が見られないのはドレライト等の火成活動の影響で胞子等の植物質が溶けたか、本源的に花粉・胞子が甚だ少ないかのいずれかである。

Plate 3. Photomicrographs of Sandstone

1. Arkose sandstone.
   DD3, 191.0m.
   crossed nicol, x85.

2. Arkose sandstone.
   DD3, 290.0m.
   crossed nicol, x85.

3. Subarkose sandstone,
   moderately well-sorted.
   DD3, 307.0m.
   crossed nicol, x85.

Remarks.
   Qt: quartz, Or: orthoclase,
   Pl: plagioclase,
   Mu: muscovite, Bi: biotite,
   Se: sericite.

1.

2.

3.

Plate 4. Photomicrographs of Palynomorphs

1. Part of Spore (Dissacate).
   DD3, 65.0m, x700.

2. Spore (Dissacate)?
   DD3, 65.0m, x700.

3. Spore (Dissacate)?
   DD3, 65.0m, x700.

1.

2.

3.

5　契約関係業務

昭和５６年度の試錐工事開始に当り、スワジランド政府及び試錐下請業者との間で下記の契約を締結した。契約の諸条項は昨年度の契約条項に準拠している。又、試錐工事実施に関する「Minutes of Meeting」をスワジランド政府との間で取交した。

- 工事実施に係る「Agreement」

  （日本側／スワジランド政府、１９８１年７月２８日付）　〔資料１〕

- 工事実施に係る「Subcontract」

  （スワジランド政府／試錐下請業者、１９８１年７月３０日付）　〔資料２〕

- 工事実施に関する「Minutes of Meeting」

  （日本側／スワジランド政府、１９８１年７月２８日付）　〔資料３〕

  工事実施の基本方針、「Scope of Work」の確認と追加事項確認、試錐計画、その他工事細部の確認。

また、試錐工事完了に伴ない次の「Memorandum」を締結するとともに、「Minutes of Meeting」を取交した。

- 工事実績量及び工事金額の確認に係る「Memorandum」

  （日本側／スワジランド政府、１９８２年２月２６日付）　〔資料４〕

- 工事完了確認に係る「Memorandum」

  （日本側／スワジランド政府／試錐下請業者、１９８２年２月２６日付）〔資料５〕

- 工事完了に関する「Minutes of Meeting」

  （日本側／スワジランド政府、１９８２年2月２６日付）　〔資料６〕

  試錐孔２２本の完了・工事実績量の確認、日本側の採取した試料、物理検層・石炭分析結果の提出、報告書提出。

- 最終試錐計画確認に係る「Memorandum」

  （日本側／スワジランド政府、１９８２年２月２６日付）　〔資料７〕

- 工事量・契約金額変更、施工期限延長に係る「Memorandum」

  （日本側／スワジランド政府、１９８２年２月２６日付）　〔資料８〕

むすび

本年度の調査では昨年度中断した3孔の継続も含めて、予定した試錐孔22本いずれも計画層準までの掘削を完了した。試錐の結果、ルブク地域北部では主要炭層であるMain Seamが良く発達し炭層も厚いが、南部では厚いドレライト・シル及び断層が発達し炭層も薄くなっていることが分った。

昨年度の調査資料に基づく国内解析では砂岩（岩相、重鉱物）、花粉・胞子による地層対比は困難であることが分ったが、物理検層は有用な一手段であることが判明した。

今後、解明すべき問題としては次の事項がある。

1）地層対比手段の確立

2）ドレライトの貫入状況と炭層に与える影響

3）断層帯等の地質構造系の解明

4）炭層の堆積環境と発達状況の解明

スワジランド王国はその第3次国家開発計画（1978~1982年度）でエネルギーの国内自給自足の達成を主な目標の一つとしている。特に石炭については同国の重要なエネルギー資源であり、石炭開発によるエネルギーの国外依存解消に大きな期待を寄せている。

更に、過去十数年にわたって同国の貴重な外貨収入源であったNgwenya鉄鉱山が1978年に閉山した為、これに代るものとして石炭輸出の外貨収入による自国の経済発展を熱望している。

上述の如くルブク地域における深部石炭試錐計画の推進は今まで未探査であったスワジランド炭田の深部に賦存する石炭のポテンシャリティを確認し、スワジランドにおけるエネルギー政策の策定上重要な意義があり、今後もより一層の協力、援助体制の強化が望まれる。

AGREEMENT FOR THE EXECUTION OF THE DRILLING INVESTIGATIONS CONCERNED WITH THE STUDY OF THE LUBHUKU AREA OF THE DEEP COAL DRILLING PROJECT UNDER THE JAPANESE TECHNICAL COOPERATION

THIS AGREEMENT made on the 28th day of July, 1981 by and between SUMITOMO COAL MINING CO., LTD., herein represented by Hajime Nozaki, leader of Lubhuku Study Team, a Japanese corporation having its principal office in Tokyo, Japan (hereinafter referred to as "SCMC") and the Government of the Kingdom of Swaziland herein represented by Timothy J. Zwane, Permanent Secretary of the Department of Economic Planning and Statistics of the Swaziland Government, having its principal office in Mbabane, the Kingdom of Swaziland (hereinaft referred to as "the Government").

WITNESSETH:

WHEREAS SCMC is nominated by JICA to execute the work as defined in this Agreement,
AND WHEREAS, in this Agreement SCMC stipulates the conditions of the drilling work which the Government executes through the Geological Survey and Mines Department of the Ministry of Commerce, Industry, Mines and Tourism with the purpose of ascertaining the geological characteristics in connection with Lubhuku area of the Deep Coal Drilling Project in the Kingdom of Swaziland, which is carried out under the Japanese technical cooperation,
AND WHEREAS, this Agreement is subject in all respects to the Scope of Work Document dated 25 March, 1980.

NOW, THEREFORE, it is agreed as follows:

1. Definition

In this Agreement, the following terms have the following meaning unless the context clearly requires otherwise:

"the WORK" means the drilling investigations in accordance with the relevant sections of the Scope of Work Document dated 25 March, 1980, and the provisions of Clause Three (3) of this Agreement.

"the Unit Price Per Meterage Basis Contract" means the fixed average

2/.....

drilling price per metre which includes all of the necessary expenses such as basic drilling prices, excess drilling prices, additives, water supply, delays, mobilization, demobilization, access road construction and site clearance.

"the Specifications" means the whole of the drilling operations stipulated in the Statement of Work which is submitted to the Subcontractors by the Government.

2. Mode of Execution

The Government shall execute the WORK by Subcontract on a Unit Price Per Meterage Basis Contract by calling for tenders for the WORK in the usual manner:
Provided that the terms and conditions, particularly with respec to the Specifications, Unit Price Per Meterage Basis Contract and total contract amount, of the Subcontract that the Governmen shall make to carry out its obligations under the Agreement shall be subject to prior consent of SCMC and to that effect the Government shall provide SCMC with two true copies of all the documents relating to the tenders mentioned above by the 12TH day of AUGUST, 1981 and two true copies of the Subcontract by the 12TH day of AUGUST, 1981.

3. Quantity and Value of the WORK Contracted

The Government shall execute the WORK in accordance with the work items and quantity specified herein, provided that the total contract value of US$ 441,691.53 shall not be exceeded.

Items	Quantity	
All Core Drillings	Number of Holes 21 OR 22	Total Drilling Length 7,160 metres (Maximum)

4. Determination of the Actual Quantity of the WORK and its Total Amount

Although the estimated amount of the WORK specified in Clause Three (3) of this Agreement is US$ 441,691.53 the actual quantity of the WORK and its total amount shall be determined by the methods established in the Subcontract (Unit Price Per Meterage Basis Contract) between the Government and the

3/.....

Subcontractor stipulated in Clause Two (2) of this Agreement in final settlement, for which SCMC's check on the results shall be required.

5. Variations in Quantity and Items and Other Variations of the WORK

SCMC may make variations in the quantity and items of the WORK stipulated in Clause Three (3) and in the Specifications that the Government has given the Subcontractor, according to conditions encountered in the process of the WORK, after consultation with the Government in terms of the Scope of Work Document dated 25 March, 1980:
Provided that SCMC shall not be required to pay for any excess amount of the WORK except in terms of this clause, and
Further Provided that such variations are made within the contract value stipulated in the aforesaid Clause Three (3).

6. Duration of the WORK

The Government shall complete the WORK within the period from the signing date of this Agreement to 14 February, 1982. Even if all the WORK should not be completed by the above date, the execution of the WORK shall be terminated on the above date except where SCMC judges otherwise.

7. Supervision of the WORK

The Government shall station engineers of its own in order to supervise the WORK at the project site while SCMC may station engineers of its own for the same purpose. SCMC shall be entitled to inspect the WORK and to certify bills for payment which the Government shall submit to SCMC.

8. Facilities and Services to be Provided for the Engineers of SCMC

The facilities and services to be provided for the engineers of SCMC shall be those undertaken by the Government in terms of the Scope of Work Document dated 25 March, 1980.

4/.....

9. Mode of Payment

SCMC shall request the Bank designated by SCMC in Tokyo to pay to the Government in United States Dollars (US$) with telegraphic transfer to a bank account designated by the Government the amounts for the executed WORK against presentation to SCMC's headquarters at Tokyo, Japan, by the Government of bills in US$ certified by one of the engineers of SCMC mentioned in Clause Seven (7) of this Agreement, in accordance with the following payment schedule.

-First Payment (Advance)	within 45 days of the signing date of the Agreement	US$ 88,338.31 (corresponding to 20% contract value of the WORK).
-Second Payment (Final)	by 10 MARCH , 1982	Amount corresponding to the total executed quantity of the WORK less first payment (advance).

The bills shall be accompanied by a certificate of the exchange rate issued by an official bank, of US$ against Swaziland Emalangeni prevailing Telegraphic Transfer Buying rate (T.T.B.) which shall be applied to the remittance making by SCMC mentioned above.

10. Receipts of Payment and Notes of Receipt Issued by an Official Bank Remitted

The Government shall immediately submit to SCMC its corresponding receipts of payment when SCMC has made payments in conformity with the provisions of Clause Nine (9) of this Agreement, and also notes of receipt issued by an official bank remitted and copies of the receipts of the Subcontractor which may substantiate the receipts of the Government.

11. Taxes, Duties and/or Any Other Levies

In case of necessity for the payment of taxes, duties and/or any other levies of any category arising in connection with this Agreement, such

taxes, duties and/or any other levies shall be borne by the Government.

12. Period of Agreement (Duration)

This Agreement comes into force on the date of signing and continues to the end of March, 1982, except with regard to payments to be made in terms of Clause Nine (9) hereof.

13. Termination

In case there is a breach of the provisions of this Agreement on the part of the Government in the opinion of SCMC, the Government shall make reimbursement to SCMC in US$ that part of the payment effected but not covered by the executed part of the WORK, and SCMC shall be entitled to terminate this Agreement forthwith by notice in writing unless such breach is remedied within the time considered by SCMC to be reasonable in the circumstances.

Termination of this Agreement is without prejudice to any claim for any antecedent breach and to the right of SCMC to recover compensation on all sums payable herewith.

The Government shall have similar rights to SCMC regarding the termination of this Agreement.

14. Force Majeure

Neither party shall be liable for failure to perform its part of this Agreement when such failure is due to fire, flood, war (declared or undeclared), blockades, legal restrictions, riots, insurrections, or any cause beyond the control of the parties.

15. Assignment

This Agreement shall not be subject to assignment by either party without the prior consent of the other party in writing and such consent shall not be unreasonably withheld.

16. Notice

Any notice, request, consent, offer or demand required or permitted to be given in this Agreement, shall be in writing

and shall be sufficiently given if delivered in person or sent by registered airmail or by telex confirmed by registered airmail letter, addressed as follows:

To:	Sumitomo Coal Mining Co., Ltd. (SCMC) (Attention: Mr. Hajime Nozaki)
(Address)	Eiraku Building, 4-5, Marunouchi 1-chome, Chiyoda-ku, Tokyo, Japan.
(Telex)	J28487 (SUMICOAL)
To:	The Government of the Kingdom of Swaziland c/o Geological Survey and Mines Department (Attention: The Director)
(Address)	P.O. Box 9, Mbabane, The Kingdom of Swaziland
(Telex)	2052 WD

Such notice, request, consent, offer or demand shall be deemed to have been served on the day on which parsonally served, or if by telex, on the date received or, if by mail, on the date of actual receipt.

17. Other Conditions

Matters not stipulated in this Agreement shall be resolved by mutual agreement of the parties hereto.

7/.....

IN WITNESS WHEREOF, the parties have executed this Agreement in duplicate by their duly authorized representatives as of the date first above written.

Signed for and on behalf of Sumitomo Coal Mining Co., Ltd. (SCMC)

by H. Nozaki
Hajime Nozaki
Leader, Lubhuku Study Team

WITNESSES:

1. M. Sugawara
2. H. Satomura

Signed for and on behalf of the Government of the Kingdom of Swaziland (the Government)

by T. Zwane 28. 07. 1981
Timothy J. Zwane
Permanent Secretary,
Department of Economic Planning
and Statistics

WITNESSES:

1. [illegible]
2. [illegible]

AGREEMENT RE THE DRILLING WORK IN THE LUBHUKU AREA

SWAZILAND

This Agreement made on 30th day of July 1981, by and between the Government of the Kingdom of Swaziland, represented by A.S. Dlamini in his capacity as Director, Geological Survey & Mines Department he being duly authorised to act herein, (hereinafter called "the CLIENT") and

INTERDRILLS (PTY) LIMITED

herein represented by M.N. Booysen in his capacity as a Director of the said campany, he being duly authorised to act herein under by virtue of a Resolution passed by the Board of Directors of the said Company dated 30th day of July, 1981, which is attached hereto and marked "A", (hereinafter called "the CONTRACTOR").

WITNESSETH:

Whereas the CLIENT desires to retain the CONTRACTOR to drill test and perform related functions in connection with the drilling for the exploration of coal resources in Lubhuku Area in the Kingdom of Swaziland in accordance with the terms and provisions hereof; and whereas the said operation shall be conducted in accordance with the instructions given to the CONTRACTOR by the CLIENT from time to time during the term hereof.

Now, therefore, it is agreed as follows:

1. Effective date

This Agreement shall become effective on the date on which the Agreement is made between the Government of Swaziland and the Sumitomo Coal Mining Company Ltd for Phase Two of the Deep Coal Drilling Project and shall continue in full force and effect to January 31, 1982. Even if all the work should not be completed by the above date, the execution of the work shall be terminated on the above date, except where the CLIENT in its discretion judges otherwise.

2. Scope of the Work

The drilling programme requires a minimum of four drill rigs, all of which shall be wire-line operated. The total length and number of boreholes to be drilled in the drilling programme shall be amended to the same as those in the Agreement to be signed between the Government of Swaziland and Sumitomo Coal Mining Company Ltd.

The drilling work shall be duly executed according to the SCOPE OF WORK DOCUMENT annexed hereto and marked "B" and which forms part of this Agreement as if set out herein verbatim.

3. Guarantees

The CONTRACTOR guarantees a minimum of 95% core recovery as stipulated in Article 6 of the SCOPE OF WORK DOCUMENT between the commencement date and the completion date as in Article 3 of the said SCOPE OF WORK DOCUMENT. The CONTRACTOR shall be required to guarantee as minimum drilling meterage performance of 1400 metres per one month unless other arrangements are made with the CLIENT because of adverse circumstances.

4. Assignment

This Agreement shall not be subject to assignment by either party without mutual consent.

5. Injury to Person and Property

The CONTRACTOR shall indemnify the CLIENT against any costs, expenses of whatever nature and/or claim for legal liability, arising out of personal, injury and/or property damage made against or incurred by the CLIENT which result from any act or omission of the CONTRACTOR, its servants or agents.

6. Insurance

The CONTRACTOR shall maintain such insurance as will protect it from all claims and damages for personal injury and property damage arising out of its operations under this Agreement, including but without limitation Public Liability Insurance in the amount as allowed for by the Workmans Compensation Act 1963 and the Regulations made there-under for all liabilities in the case of any one accident or occurrence.

7. Mode of Payment

The CLIENT agrees to pay the CONTRACTOR E 57-68 (Fifty seven Emalangeni and sixty eight cents) per unit meterage cost in Swaziland currency. The total amount of the payment shall be finally settled in the above unit meterage cost which shall be duly certified by the CLIENT.

Payment shall be made by the CLIENT within 30 days of receipt of the CONTRACTOR'S invoices.

8. CONTRACTOR to provide Everything Necessary

The CONTRACTOR shall provide everything necessary for the proper execution of the work according to the true intent and meaning of the SCOPE OF WORK DOCUMENT.

9. Local and other Authorities Notices and Fees

The CONTRACTOR shall comply with and give notices required by any Government Notices, Regulations and By-laws of any Local Authority and/or any public service company or authority relating to the Work and it shall pay and indemnify the CLIENT against any fees or charges demandable by law in respect of the work, provided that the said fees and charges if not expressly included in the contract sum shall be added to the contract sum and be payable to the CONTRACTOR accordingly.

10 Access to CLIENT'S Representatives

The CLIENT and its representatives shall at all times have access to all places which are being used in connection with the work.

11 Failure of the CONTRACTOR to complete the contract in due time

If the CONTRACTOR fails to complete the work by 31 January, 1982 the CONTRACTOR shall pay or allow to the CLIENT as liquidated and ascertained damages the sum of E500.00 per machine per day, unless the CONTRACTOR is prevented from completing such work by the CLIENT or by Force Majeure.

12 Failure by the CONTRACTOR to comply with the CLIENT'S instructions

If the CONTRACTOR after receipt of a written notice from the CLIENT requiring immediate compliance fails to comply with the CLIENT'S instructions in accordance with this Agreement the CLIENT may employ and pay other persons to execute any work whatsoever which may be necessary to give effect thereto and all costs incurred in connection therewith shall be recoverable from the CONTRACTOR by the CLIENT as a debt or may be deducted by the CLIENT from any monies due or to become due to the CONTRACTOR.

13 Termination of Contract by the CLIENT

1. If the CONTRACTOR shall make default in any the following respects:

   (a) without reasonable cause wholly suspend the work before completion;

   (b) fails to proceed with the work with reasonable diligence and

(c) refuses or to a substantial degree persistently neglects after notice in writing from the CLIENT to remove or replace defective work, equipment, and/or materials, or unsatisfactory personnel then if such default continues for three (3) days after written notice to the CONTRACTOR from the CLIENT specifying the same, the CLIENT may, without prejudice to any other rights herein contained, thereupon by written notice determine this contract.

2. If the CONTRACTOR is placed in voluntary or compulsory liquidation except for the purposes of reconstruction, the CLIENT may, without prejudice to any other rights herein contained, by notice determine this contract.

3. In either of the above cases the following shall apply:

(a) the CLIENT may employ and pay a contractor or other person or persons to carry out and complete the work and it, he or they may enter upon the site and use all materials, temporary buildings, plant and appliances thereon and may purchase all materials necessary for the purposes aforesaid.

(b) the CONTRACTOR shall if so required by the CLIENT assign to the CLIENT without further payment the benefit of any contract for the supply of materials and/or works intended for use under this contract or for the execution of any work and the CLIENT shall pay the agree price, if unpaid, for such materials or works supplied or executed after the said termination.

(c) the CONTRACTOR shall during the executions or after completion of the work under this clause as and when required move from the site his temporary buildings, plant, appliances and any materials within such reasonable time as the CLIENT may specify in a written notice to it and in default

the CLIENT may without being responsible for any loss or damage remove and sell the same holding the proceeds less all costs incurred to the credit of the CONTRACTOR.

(d) until after completion of the work under this clause no payment shall be made to the CONTRACTOR under this contract provided upon completion as aforesaid and the verification within a reasonable time of the accounts therefor, if such amount added to the monies paid to the CONTRACTOR before such termination exceeds the total amount which would have been payable on due completion, the difference shall be a debt payable to the CLIENT by the CONTRACTOR and if the said amount added to the said monies be less than the said total amount the difference shall be a debt payable by the CLIENT to the CONTRACTOR.

14. Access to land

The CONTRACTOR shall have free and unimpeded access to the land with which the work is concerned, save, however, in gaining such access it shall observe the laws and customs of Swaziland.

15. Applicable law

The law applicable to this Agreement shall be the law of Swaziland.

16. Safety Measures

The CONTRACTOR shall, in connection with the Work, provide and maintain at its own cost all lights, guards, fencing and/or watching, where and when necessary or required by

the CLIENT'S representative, or by any duly constituted authority for the protection of the works, or for the safety and convenience of the public and others including the property of same.

17 Notices

Any Notice to be given to the CONTRACTOR under the terms of this Agreement shall be delivered by hand or sent by registered post to the following address:

To: Interdrills (Pty) Limited,
(Address): P.O. Box 11296,
Brooklyn,
0011,
South Africa.

Any notice to be given to the CLIENT under the terms of this Agreement shall be delivered by hand or sent by registered post to the following address:

To: The Government of the Kingdom of Swaziland,
c/o Geological Survey and Mines Department,
(Attention: The Director).

(Address): P.O. Box 9,
MBABANE,
The Kingdom of Swaziland.
Telex: 2052 WD.

Any Notice sent by registered post shall be deemed to have been delivered five days after posting.

18 Domicilium Citandi et Executandi

The CONTRACTOR chooses domicilium citandi et executandi at the same address given for the service of notices about and the CLIENT in like manner chooses domicilium citandi executandi at the same address given for the service of notices above.

19. <u>Costs of Agreement</u>

Each party to this Agreement shall bear its own costs.

Signed for and on behalf of <u>The Government of the Kingdom of Swaziland</u> (CLIENT)

by

<u>WITNESSES</u>

1.

2.

Signed for and on behalf of <u>INTERDRILLS (PTY) LTD</u> (CONTRACTOR)

by

<u>WITNESSES</u>

1.

2.

SCOPE OF WORK DOCUMENT
PHASE TWO OF THE DEEP COAL DRILLING PROJECT IN THE LUBHUKU AREA, SWAZILAND

1. Location

The area to be drilled is located in the lowveld about 100 kilometers east of Mbabane. Access to this area is relatively good and the terrain is gentle.

2. Scope of Work

The drilling programme requires four wire-line operated rigs to drill approximately 7160 meters (maximum) in 21 or 22 boreholes at "N" or "B" size depending upon whether plan "A" or Plan "B" is chosen; the boreholes are estimated to be not less than 200 meters in total depth and not greater than 550 meters. Drilling after 500 meters will be at a size to be determined by the Contractor. All boreholes are to be drilled vertical. The boreholes will be in a general area of 100km^2. The boreholes will be surveyed by the Client using geophysical logging and by the Contractor for deviation using agreed survey methods when required by Client. Three (3) of the proposed 21 or 22 boreholes, namely boreholes DD8, DD10 and DD48, have already been drilled at "N" size to approximately 300 meters depth. The proposed contract requires that these boreholes be fully cased to this depth using "B" casing before drilling restarts. Drilling to complete these 3 boreholes will be at "B" size only. In the remainder of the boreholes drilling will be at "N" size unless a reduction to "B" size is agreed by the Client. The Contractor may be required to use a "TNW" or "TBW" corebarrel when drilling through the thicker coal seams in all of the boreholes.

3. Commencement Date

Drilling shall commence on or before the first day of September 1981 but is expected to commence on the first of August 1981, and to be terminated not later than the thirty first day of January 1982.

4. Access and site Preparation

The Contractor will prepare all the drill sites, access tracks to each site suitable for drill rig haulage and for 2-wheel drive vehicles, and is to provide a water supply system to each site. Experienced sub-contractors are available in Swaziland to carry out part or all of this work and any costs so incurred would be the responsibility of the Contractor.

5. Nature of the Ground

The predominant rock types expected to be drilled are sandstone, shale, and coal, and dolerite sills or dykes may be expected to occur. Each drilling site is to be located so as to drill the minimum amount of dolerite by means of a magnetometer and geological survey carried out by the Client prior to the start of the drilling.

6. Core Recovery

6.1 All the work is to be carried out in such a manner that maximum core recovery will be obtained over the entire length of the borehole. If the core recovery is less than 95%, and if such drilling is acceptable to the Client payment will be made only for the actual meterage recovered. If the core recovery is less than 95%, and unacceptable for geological evaluation, the Client may demand the Contractor to re-drill to any specified length until maximum recovery is obtained. The charges for such re-drilling shall be paid by the Contractor.

6.2 The Contractor is expected to use NQ or BQ wire-line equipment and NQ, TNW, BQ or TBW corebarrels throughout the contract unless otherwise agreed in writing with the Client.

6.3 The Contractor is to provide all necessary core boxes for the contract. The depth at the end of each core run is to be marked in meters both on the core and in the core boxes with suitable markers. The Contractor will place the core in the core-boxes and will be responsible for the core until it is delivered to the Client. The Contractor shall ensure that no core is lost prior to delivery. The Contractor is to prepare an acceptable core splitter prior to the start of the contract.

7. Sludge Sampling

The Contractor shall agree to take sludge samples where requested during the drilling. All sludge samples shall be washed and placed by the Contractor's employees in containers and carefully marked. If required the Contractor is to prepare a sludge splitter to split the returning mud water.

8. Drill Machine, Tools and Ancillary Equipment

8.1 The Contractor shall provide Longyear 38 wireline drillin machines (or their equivalent), preferrably truck or trailer mounted, and all other tools and ancillary equipment for this operation. The Contractor shall use only diesel powered (motorized) equipment. The Contractor shall provide details of the drilling equipment that he will use in this contract when submitting his tender.

8.2 Ancillary equipment means all equipment necessary to complete the drilling operations, such as flush pumps, supply pumps, mud tanks, core barrels, rods, core tubes, diamond bits, casings, sludge sample collectors, etc. and all other items required but not mentioned.

8.3 The Contractor shall maintain at the drill site in a lockable store room adequate supplies of rods, casings, bits, and other operating stores and equipment to allow drilling to proceed without delay. The Contractor is also required to maintain and have available an adequate stock of spares for the drilling plant to ensure that only minimum delay is occasioned by plant breakdown.

9. Transportation of Equipment

The Contractor shall provide a minimum of two lorries always on site for the transportation of the Contractor's drills, accessories, fuel, lubricants, oils, muds, cement, etc.

10 Qualified Personnel

10.1 The Contractor shall provide qualified drillers to carry out the work and shall pay for all their expenses. The hours of work per day shall be negotiated with the Contractor and then shall form part of the contract.

10.2 The Contractor should provide details of the qualifications and experience of the drillers who would be employed on this contract when submitting his tender.

10.3 The Client may require the Contractor to replace any driller whose performance is unsatisfactory, in respect of displaying irresponsibility or failing to comply scrupulously with instructions given by the Client or in respect of ability or in any other respects prejudicial to obtaining good results from the work.

10.4 Where the Client is dissatisfied with the performance or general conduct of any employee of the Contractor at the site, he may require the Contractor to have the employee replaced, and the Contractor shall be bound to do so.

10.5 All or any expenses incurred by the Contractor in such actions shall be to the Contractor's account. Any drill down-time or any drill costs occasioned by such a replacement will not be for Client's account.

11. Camp Arrangements

The Contractor shall make all the necessary arrangements for camps for his personnel including facilities required. The location of each camp site shall be agreed with the Client and as required with any local authority or landowner.

12. Hole Completed

Upon the completion of drilling, the Contractor shall consult with the Client to determine if the drill rods should be withdrawn from the borehole. The Client may then request the Contractor to circulate mud or fresh water for an appropriate number hours prior to geophysical logging. After the circulation of mud or fresh water, the drill rods should be withdrawn from the borehole at the indication of the Client and total meterage drilled should be determined by measuring the total length of rods laid out at the drill site.

13. Geophysical Logging

Before removing the casing after the termination of drilling, and before the Contractor leaves the drill site, the Client will endeavour to geophysically log each borehole. The Contractor shall support the operation adequately in particular by fitting casing where required, and by endeavouring to keep the boreholes open and free from blockage.

14. Stopping of boreholes

The Contractor should stop each borehole and do the necessary reclamation of the drilling site according to the Client's instructions and the appropriate regulations.

15. Re-Drilling

If in the opinion of the Client, the hole is lost due to negligence of the Contractor or his employee and it is to be re-drilled, the Contractor will not be paid for the new borehole until it reaches the top of the 3 meters interval above the depth from which core or sample was last recovered in the abandoned hole. However, if in the opinion of the Client, the hole was lost due to circumstances beyond the control of the Contractor and has to be re-drilled, payment will be made for the new hole at the contract rates applying.

16. Water Supply

The Contractor shall provide sufficient water supply for the drilling operation. Any downtime and costs thereon resulting from the failure of water pumps or the supply, shall be the responsibility of the Contractor.

17. Fuel, Lubricants, etc.

The Contractor shall be responsible for the purchase of fuel, lubricants, soluble oils, mud materials, cement and other additives as required.

18. Reports

The Contractor will be required to complete daily drilling log sheets and daily reports supplied by the Client in order to provide a complete record of work carried out on each shift. Current daily drilling log sheets and drilling reports of the Contractor shall be available at the site for the inspection by the Client.

19. Contract Basis

All expenses and accounts are to be estimated on a unit price per meterage basis, which means the average cost per meter. The Contractor is required to tender on a unit price

per meterage basis cost which has to include all drilling costs, access road construction costs, water supply costs, mobilization and demobilization costs, and any other costs required.

20. Summary

In submitting a tender for this contract the Contractor is required to state:

20.1 The unit price per metre for the contract (see in particular Section 19, and also the remainder of the Scope of Works document).

20.2 Details of the drilling equipment to be used in the contract (see Section 8).

20.3 Details of the qualifications and experience of the drillers to be employed on the contract (see Section 10).

20.4 Details of previous experience of the Contractor in drilling for coal, particularly in Swaziland.

20.5 The arrangement required for the payment of accounts submitted for this contract.

MINUTES OF MEETING HELD ON 28TH JULY, 1981 ABOUT THE EXECUTION OF THE DRILLING INVESTIGATIONS FOR THE STUDY OF THE LUBHUKU AREA OF DEEP COAL DRILLING PROJECT IN PHASE TWO

The Lubhuku Study Team dispatched by the Japan International Cooperation Agency, headed by Mr. H. Nozaki (The First Part) exchanged views and had a series of discussions in The Kingdom of Swaziland from 21st to 28th July, 1981 with the representatives of the Government of the Kingdom of Swaziland, named the Geological Survey and Mines Department; the Ministry of Commerce, Industry, Mines and Tourism; the Department of Economic Planning and Statistics and the Attorney-General's Chamber (The Second Part) on the execution of the drilling investigations in the Lubhuku area in Phase Two.

As the result of the discussions, the following items were understood to be agreed on by both parties:

1. that the drilling investigations should be executed in accordance with the "Minutes of Meeting" dated 25th March 1980, the "Scope of Work" dated 25th March, 1980 and the "Agreement for the Execution of the Drilling Investigations" dated 28th July, 1981.

2. that both parties should consult with each other regarding the execution of the drilling investigations.

3. that the items described in the Attachment were confirmed and agreed by both parties.

Mbabane, 28th July, 1981.

HAJIME NOZAKI
Leader of Lubhuku Study Team

for TIMOTHY M.J. ZWANE
Permanent Secretary,
Department of Economic Planning
and Statistics

ATTACHMENT

1. The relevant sections of the Scope of Work and the Minutes of Meeting dated 25 March, 1980 were confirmed by both parties.

In addition to the above, following items were also confirmed and agreed.

1.1 Following Counterpart Team to work with the Lubhuku Study Team throughout the investigation period were nominated and authorized.

Mr. M.C. McKeown	(Project Coordinator)
Mr. F. Stocks	(Drilling Engineer)
Mr. S.N. Maphanga	(Geologist)
Mr. M.M. Magagula	(Trainee Geologist)
Mr. L. Strachan	(Geologist)

1.2 The following JICA Experts stationed in Swaziland cooperate with the Lubhuku Study Team as and when available throughout the duration of the Project.

Mr. H. Satomura
Mr. K. Kumagai
Mr. T. Kawaguchi

1.3 Telex facilities and services of the Geological Survey and Mines Department's headquarters in Mbabane will be provided for the Lubhuku Study Team, however, dispatched telex charges should be borne by the Team.

2. DRILLING PLAN

The location of the drilling sites and the drilling length of each borehole for the Phase Two (financial year 1981/1982) are shown as a tentative plans "A" and "B" in Appendix 1 and Appendix 2, respectively.
Actual drilling operations should be done according to the above plan "A" or "B" with possible minor variations in either of the plans depending upon the conditions encountered in the process of the drilling operations.

3. EXECUTION OF THE DRILLING INVESTIGATIONS

3.1 Preliminary survey of the planned borehole sites and the cutting of the lines for magnetometry survey should be done by local surveyor and labourers, of which expenses should be borne by the Geological Survey and Mines Department.

3.2 The survey to determine the related location of the boreholes in connection with the nearest tentative base point should be done after completion of drilling by the Lubhuku Study Team at its own expenses.

3.3 The engineers of both parties stationed at the drilling sites should consult with each other about the termination of each borehole, however, the Lubhuku Study Team has an option to terminate the borehole when the engineers of the Geological Survey and Mines Department are not available at the site at week ends or during public holidays.

3.4 Magnetometry survey carried out by the Geological Survey and Mines Department should be completed prior to the commencement of each borehole in order to select the actual drilling location to drill the minimum amount of dolerite.

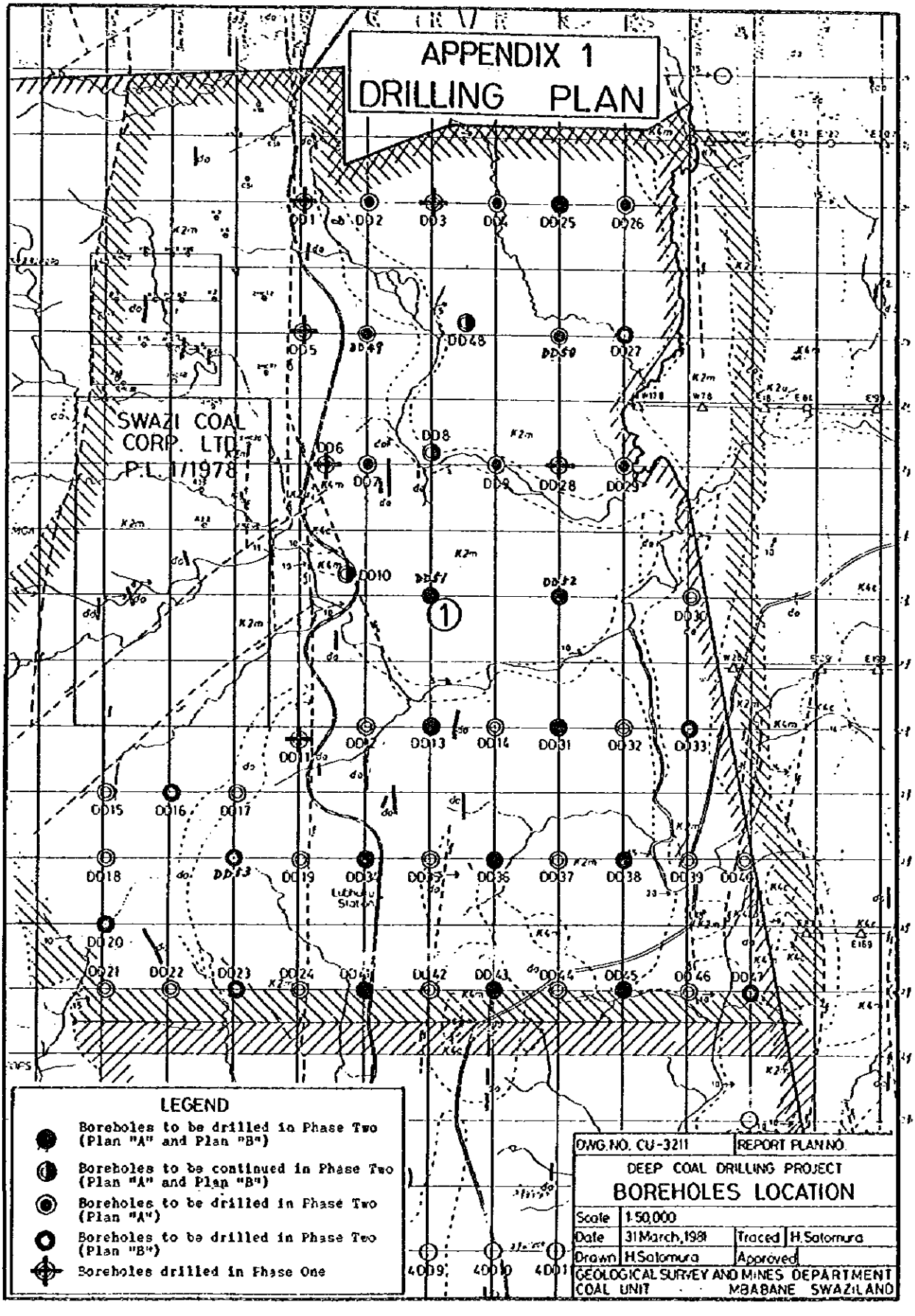
3.5 Geophysical logging carried out at the expenses of the Geological Survey and Mines Department should be arranged as early as possible after the completion of boreholes to obtain the best results.

4. Both parties should occasionally consult with each other on the following items.

4.1 Carrying out the analyses of drill core as stated in Section 5.6 of the Scope of Work document.

4.2 Standard of coal reserve calculation.

4.3 Preparation of investigation report which shall be issued after the completion of drilling work in Phase Two.


APPENDIX 1
DRILLING PLAN
SWAZI COAL
CORP. LTD.
P.L. 1/1978
LEGEND
Boreholes to be drilled in Phase Two (Plan "A" and Plan "B")
Boreholes to be continued in Phase Two (Plan "A" and Plan "B")
Boreholes to be drilled in Phase Two (Plan "A")
Boreholes to be drilled in Phase Two (Plan "B")
Boreholes drilled in Phase One
DWG.NO. CU-3211
REPORT PLAN NO.
DEEP COAL DRILLING PROJECT
BOREHOLES LOCATION
Scale 1:50,000
Date 31 March, 1981
Traced H.Satomura
Drawn H.Satomura
Approved
GEOLOGICAL SURVEY AND MINES DEPARTMENT
COAL UNIT MBABANE SWAZILAND

APPENDIX 2

DEEP COAL DRILLING PROJECT IN LUBHUKU AREA

FOR PHASE TWO, JICA

I. PLAN "A"

DDH NO.	Drilling Length	DDH NO.	Drilling Length
1. DD2*2	205 metres	12. DD38	445 metres
2. DD4*2	320 "	13. DD41	130 "
3. DD7*2	370 "	14. DD43	275 "
4. DD9*2	385 "	15. DD45	370 "
5. DD13	395 "	16. DD49*2	290 "
6. DD25	400 "	17. DD50*2	300 "
7. DD26*2	475 "	18. DD51	455 "
8. DD29*2	460 "	19. DD52	520 "
9. DD31	490 "	20. DD8*1	70 "
10. DD34	265 "	21. DD10*1	100 "
11. DD36	350 "	22. DD48*1	90 "

Total 22 Boreholes, Total Drilling Length 7,160 metres

II. PLAN "B"

DDH NO.	Drilling Length	DDH NO.	Drilling Length
1. DD13	395 metres	12. DD41	130 metres
2. DD16*2	330 "	13. DD43	275 "
3. DD20*2	275 "	14. DD45	370 "
4. DD23*2	350 "	15. DD47*2	515 "
5. DD25	400 "	16. DD51	455 "
6. DD27*2	465 "	17. DD52	520 "
7. DD31	490 "	18. DD53*2	350 "
8. DD33*2	520 "	19. DD8*1	70 "
9. DD34	265 "	20. DD10*1	100 "
10. DD36	350 "	21. DD48*1	90 "
11. DD38	445 "		

Total 21 Boreholes, Total Drilling Length 7,160 metres

Remarks: 1. Eleven boreholes (DD13, 25, 31, 34, 36, 38, 41, 43, 45, 51 and 52) and three boreholes (DD8, 10 and 48) which was discontinued in Phase One, marked *1, will be drilled in the first half of the investigation period.

2. Those boreholes of eight (DD2, 4, 7, 9, 26, 29, 49 and 50) in Plan "A" or seven (DD16, 20, 23, 27, 33, 47 and 53) in Plan "B", marked *2, will be drilled in the latter half depending upon the conditions encountered in the process of the drilling operations in the first half.

M E M O R A N D U M

With respect to the "Agreement for the Execution of the Drilling Investigations Concerned with the Study of the Lubhuku Area of the Deep Coal Drilling project under the Japanese Technical Co-operation" dated July 28, 1981, Sumitomo Coal Mining Co., Ltd., represented by Hajime Nozaki, Leader of the Lubhuku Study Team, and the Government of the Kingdom of Swaziland, represented by V.E. Sikhondze, Permanent Secretary of the Department of Economic Planning and Statistics of the Swaziland Government hereby mutually agreed and confirmed the actual quantity of the executed drilling work and its total amount as follows:

1. Actual Quantity of the Executed Drilling Work: 7,835.22 metres

Details:

DD 2	241.13 metres	DD41	235.48 metres
DD 4	325.36 "	DD43	320.13 "
DD 7	340.14 "	DD45	400.65 "
DD 9	395.40 "	DD49	241.99 "
DD13	421.15 "	DD50	426.19 "
DD25	418.13 "	DD51	441.38 "
DD26	471.88 "	DD51A	3.00 "
DD29	465.22 "	DD52	492.65 "
DD31	544.34 "	DD 8	135.21 "
DD34	321.27 "	DD10	104.46 "
DD36	362.80 "	DD48	227.98 "
DD38	499.28 "		

2. Total Amount of the Executed Drilling Work: US$ 466,338.87

Details:

2.1 Total Amount in Swaziland Emalangeni:
E 57.68/metre x 7,835.22 metres = E 451,935.42

2.2 Advance Payment Received on September 11, 1981:
E 84,051.67 x 1.0510 = US$ 88,338.31 ..... (A)

2.3 Final Payment to be Remitted by March 10, 1982:
(E 451,935.42 - E 84,051.67) x 1.0275 = US$ 378,000.56..(B)

2.4 Total Amount in US Dollars ((A) + (B)):
US$ 88,338.31 + US$ 378,000.56 = US$ 466,338.87

Mbabane, February 26 1982.

Sumitomo Coal Mining Co., Ltd.

by H. Nozaki

Hajime Nozaki
Leader, Lubhuku Study Team

The Government of the Kingdom of Swaziland.

by

V.E. Sikhondze
Permanent Secretary
Department of Economic Planning and Statistics.

MEMORANDUM

With respect to the execution of the drilling work in the Lubhuku area of the Deep Coal Drilling Project during financial year 1981/1982, the Lubhuku Study Team dispatched by Japan International Cooperation Agency, represented by Hajime Nozaki, Leader of the Team ("JICA Team"), the Government of the Kingdom of Swaziland, represented by V.E. Sikhondze, Permanent Secretary of the Department of Economic Planning and Statistics of the Swaziland Government ("the Government") and Interdrills (Pty) Limited, represented by M.N. Booysen, Director of the Company ("Interdrills") hereby mutually agreed and confirmed that the drilling work had been completed with the total quantity of 7,835.22 metres on February 17, 1982 and the Agreement dated July 28, 1981 between Sumitomo Coal Mining Co., Ltd. and the Government and the Agreement dated July 30, 1981 between the Government and Interdrills had been satisfied in accordance with the terms and conditions of the relevant Agreement.

Mbabane, February 26, 1982.

Lubhuku Study Team ("JICA Team")

H. Nozaki

Hajime Nozaki
Leader

The Government of the Kingdom of Swaziland
("the Government")

V.E. Sikhondze
Permanent Secretary
Department of Economic Planning and Statistics

Interdrills (Pty) Limited ("Interdrills")

M Booysen

M.N. Booysen
Director

MINUTES OF MEETING HELD ON 26TH FEBRUARY, 1982 ABOUT THE DRILLING INVESTIGATIONS FOR THE STUDY OF THE LUBHUKU AREA OF DEEP COAL DRILLING PROJECT IN THE PHASE TWO

The Lubhuku Study Team dispatched by the Japan International Cooperation Agency, headed by Mr. H. Nozaki, exchanged views and had a series of discussions in the Kingdom of Swaziland with the representatives of the Government of Swaziland namely the Department of Economic Planning and Statistics and the Geological Survey and Mines Department of the Ministry of Commerce, Industry, Mines and Tourism, on the drilling investigations carried out in the Lubhuku area in the Phase Two of the Deep Coal Drilling Project. As the results of the discussions, the following items were understood and agreed by both parties:

1. that the drilling investigations at twenty-two boreholes, namely DD2, DD4, DD7, DD9, DD13, DD25, DD26, DD29, DD31, DD34, DD36, DD38, DD41, DD43, DD45, DD49, DD50, DD51, DD52, DD8, DD10 and DD48, had been well performed and good results were obtained about the geological information of the Lower Coal Zone in the Ecca Series.

2. that the executed drilling work in the Phase Two of 7,835.22 metres were confirmed and agreed by both parties and payment for these executed work should be fully done in accordance with the stipulations in the Agreement dated July 28, 1981.

   Details of the executed drilling work are shown below;

DD2	241.13 metres	DD41	235.48 metres
DD4	325.36 "	DD43	320.13 "
DD7	340.14 "	DD45	400.65 "
DD9	395.40 "	DD49	241.99 "
DD13	421.15 "	DD50	426.19 "
DD25	418.13 "	DD51	441.38 "
DD26	471.88 "	DD51A ※1	3.00 "
DD29	465.22 "	DD52	492.65 "
DD31	544.34 "	DD8 ※2	135.21 "
DD34	321.27 "	DD10 ※2	104.46 "
DD36	362.80 "	DD48 ※2	227.98 "
DD38	499.28 "		

   Total 7,835.22 metres

   Remarks.

   ※1 : Actual drilling length of DD51A showed 53.93 metres, however, executed drilling length of this borehole should be recorded 3.00 metres as redrill of the borehole was due to negligence of the Subcontractor according to Item 15 of the Annex "B" attached to the Agreement dated July 30, 1981 between the Government of Swaziland and the Subcontractor.

   ※2 : These 3 boreholes, discontinued in the Phase One because of bad strata conditions, have been well continued to drill upto the planned depth.

2/.....

3. that a total of seventeen coal samples, as follows:

Main Seam (DD4, DD13, DD25, DD29, DD38, DD50, DD51)	12 samples
Intermediate Marker Seam (DD25, DD38, DD49)	3 samples
Footwall No.3 Seam (DD13, DD25)	2 samples

together with several samples of dolerite were taken by the Lubhuku Study Team to carry out tests in Japan as agreed in the Scope of Work document.

4. that results of geophysical logging and analyses and tests of coal samples carried out by the Swaziland Government as agreed in the Scope of Work document should be presented to the Lubhuku Study Team by the end of May, 1982 for the preparation of the report mentioned in Item 5.

5. that the Lubhuku Study Team will study geological data obtained during the investigations in Phases One and Two and the results of these study are to be explained to the Government of Swaziland at Mbabane in the form of draft report as soon as possible for finalization of the report, and then final report for Phases One and Two is to be presented to the Government.

6. that both parties were pleased with the amount of mutual cooperation which has been achieved also during the Phase Two of the project and look forward to continued cooperation and good relationship during the preparation of the report.

Mbabane, February 26, 1982.

Lubhuku Study Team

by H. Nozaki

Hajime Nozaki
Leader

The Government of the Kingdom of Swaziland

by

V.E. Sikhondze
Permanent Secretary
Department of Economic Planning and Statistics

M E M O R A N D U M

With respect to the "Drilling Plan" in Item 2 of the Attachment to the "Minutes of Meeting held on 28th July, 1981 about the Execution of the Drilling Investigations for the Study of the Lubhuku Area of Deep Coal Drilling Project in Phase Two", the Government of the Kingdom of Swaziland and the Lubhuku Study Team dispatched by JICA hereby mutually agreed and confirmed the following final drilling plan to be actually executed in the Phase Two (financial year 1981/82) considering the conditions encountered in the executed drill holes, according to the stipulation in Second Paragraph in Item 2 of the Attachment in the said Minutes of Meeting.

Final Drilling Plan

Drill holes to be executed in the Phase Two.

DD2	DD31	DD50
DD4	DD34	DD51
DD7	DD36	DD52
DD9	DD38	DD8*
DD13	DD41	DD10*
DD25	DD43	DD48*
DD26	DD45	
DD29	DD49	

Total 22 Boreholes.

Remarks. * : Discontinued boreholes in Phase One.

Mbabane, February 26, 1982.

The Government of the Kingdom of Swaziland

V.E. Sikhondze
Permanent Secretary
Department of Economic Planning and Statistics

Lubhuku Study Team

Hajime Nozaki
Leader

M E M O R A N D U M

With respect to the "Agreement for the Execution of the Drilling Investigations Concerned with the Study of the Lubhuku Area of the Deep Coal Drilling Project under the Japanese Technical Cooperation" dated July 28, 1981 ("the Agreement"), between Sumitomo Coal Mining Co., Ltd. ("SCMC") and the Government of the Kingdom of Swaziland ("the Government"), the parties hereby mutually confirmed that the Clauses Three (3) and Four (4) of the Agreement shall be amended as mentioned below as the parties agreed the variations of the Quantity and Value of the WORK Contracted based on the stipulations in Clauses Five (5) and Seventeen (17) of the Agreement, and further that the Clause Six (6) of the Agreement shall be amended as mentioned below as SCMC judged the necessity of extension of the completion date of the WORK based on the stipulation in Clause Six (6) of the Agreement.

3. Quantity and Value of the WORK Contracted

The Government shall execute the WORK in accordance with the work items and quantity specified herein, provided that the total contract value of US$483,345.01 shall not be exceeded.

Items	Quantity	
All Core Drillings	Number of Holes	Total Drilling Length
	22	7,835.22 metres (Maximum)

4. Determination of the Actual Quantity of the WORK and its Total Amount

Although the estimated amount of the WORK specified in Clause Three (3) of this Agreement is US$483,345.01, the actual quantity of the WORK and its total amount shall be determined by the methods established in the Subcontract (Unit Price Per

2/.....

Meterage Basis Contract) between the Government and the Subcontractor stipulated in Clause Two (2) of this Agreement in final settlement, for which SCMC's check on the results shall be required.

6. Duration of the WORK

The Government shall complete the WORK within the period from the signing date of this Agreement to February 20, 1982. Even if all the WORK should not be completed by the above date, the execution of the WORK shall be terminated on the above date except where SCMC judges otherwise.

Mbabane, February 26, 1982.

Sumitomo Coal Mining Co., Ltd. ("SCMC")

H. Nozaki

Hajime Nozaki
Leader, Lubhuku Study Team

The Government of the Kingdom
of Swaziland ("the Government")

V.E. Sikhondze
Permanent Secretary
Department of Economic Planning
and Statistics


JICA